Performance Evaluation of the Africa Research in Sustainable Intensification for the Next Generation (Africa RISING) Program

Final Report

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Review Team

The Review Team consists of three experts with complementary technical backgrounds, knowledge, and experience:

- Christine Negra, PhD (Review Team Chair) is an international consultant specializing in climate change, sustainable agriculture, and integrated landscape management and is principal of Versant Vision LLC (http://www.versantvision.com/). As a soil chemist with 25 years of experience as an Extension agent, a researcher, and a program director, she collaborates with international development, research, and finance organizations on multi-disciplinary projects, including evaluation design and implementation.
- J. Mark Powell, PhD is a Professor Emeritus in the Department of Soil Science, University of Wisconsin-Madison, retired USDA Research Soil Scientist and has 45 years of experience in farming systems research and development. He is recognized nationally and internationally for his expertise in mixed crop-livestock farming systems in tropical, sub-tropical, and temperate environments. His publications (https://soils.wisc.edu/people/emeritus/powell/) highlight how integrated soil, crop, animal, and social science can be used to enhance project outcomes leading to sustainable and productive crop-livestock farming systems.
- Nancy McCarthy has a PhD in Agricultural Economics from UC Berkeley, and a JD from George Mason University School of Law. She has extensive experience in researching social capital, cooperation, and collective action, specifically with respect to sustainable technology adoption, natural resource management, and climate resilience. In addition, she has implemented a wide range of agriculture-focused project impact analyses, using both quantitative and qualitative methods applied at different institutional levels (e.g. household, community, watershed / market shed, legal system).

All three members contributed to the Interim Report (submitted November 2019), which provided the foundation for this Final Report, which has been prepared by Christine Negra and J. Mark Powell.

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Evaluation supplement on activity reporting in Ghana and Mali provided under separate cover.

Summary

Focusing on all three regions of the Africa Research In Sustainable Intensification For the Next Generation (Africa RISING) program, this Final Report presents key findings and recommendations arising from the Phase II mid-term internally commissioned external evaluation.

Program successes

Major areas of success during Phase II include:

- Vibrant inter-CGIAR, governmental, and non-governmental research and development partnerships that facilitate meaningful contributions by diverse participating organizations, while generating shared benefits.
- An array of validated crop, vegetable, livestock, land management, and food processing, preparation, and nutrition technologies (including relevant tools, strategies, and approaches) with demonstrated short-, medium-, and long-term value to smallholder farmers, clear relevance to sustainable agriculture and food security, and potential for scaling through public, private, and philanthropic sector pathways.
- Strong synergies across the objectives of farmers, researchers, community organizations, local government, and others, anchored in energetic participation of direct engagement (male and female) farmers.
- A robust legacy of capacity building grounded in training of graduate students, site coordinators, field technicians, Extensionists, NGO staff, development practitioners, scaling partners, participating farmers, and other contributors to technology development and validation.
- Consistent alignment with government priorities and notable efforts to increase the value of public investments (e.g. in improved crop varieties and subsidized fertilizers) and to leverage complementary funding.
- Substantial delivery against USAID's mandate and priorities.

These successes are especially commendable in view of the profound and persistent budgetary challenges affecting every aspect of the Africa RISING program during much of Phase II. Since AR program leaders do not have the power to alter USAID budget processes, this report does not dedicate significant attention to budget issues nor offer related recommendations. However, the Review Team is aware that perennial uncertainty regarding budget amounts and lengthy delays in disbursement have adversely affected staffing, partnering, research planning and implementation, farmer engagement, and many other aspects of the AR program. Indeed, budget uncertainties will influence the feasibility of many of the Review Team's recommendations.

Priority recommendations

The Review Team built a set of forty-four recommendations from the 'bottom up' using a structure that closely mirrors the mid-term evaluation Terms of Reference.[1] Within the five major sections, each sub-section has its own short set of recommendations. Each recommendation is supported by observations and rationales.

Here we present twenty-two higher priority recommendations grouped into four cross-cutting topics. Recognizing budget and capacity limitations, these recommendations point to opportunities to synthesize major program achievements and fill programmatic gaps while tapering down technology validation activities.

Learning – The Africa RISING program has built an impressive research portfolio that should be mined for knowledge and insight relevant to the broader agricultural development community. Given the breadth of the AR body of work, the Review Team encourages focusing on high-potential outcomes in targeting harmonization efforts [*Recommendation 1.2-A*], in supporting program-wide analyses and success stories

[1] Importantly, the Terms of Reference direct the Review Team to address the AR program structure, partnerships, and alignment with key constituencies as well as progress toward established research objectives; it does not request assessment of specific technologies.

[*Recommendation 2.4-A*], and in incentivizing cross-regional collaborations [*Recommendation 1.2-B*]. The Review Team recommends increased effort toward estimating technology impacts (on household food security, income, and nutrition) through meta-analyses [*Recommendation 4.2-A*] and toward identifying and communicating technology tradeoffs for specific farm, landscape, and supply chain contexts to end users [*Recommendation 4.4-B*].

Amplifying scaling – Effective scaling of AR-validated technologies is essential to the success of the AR program. The Review Team encourages a more explicitly defined learning agenda for scaling processes [*Recommendation 3.2-A*] that systematically documents hypotheses and evidence related to technology adoption and scaling [*Recommendation 4.7-A*] and defines and assesses how farmers are targeted for direct engagement in AR projects [*Recommendation 3.2-B*]. Given the keen interest expressed by farmers regarding improved crop varieties, the Review Team recommends systematically characterizing and addressing seed access challenges [*Recommendation 3.1-D*] including through policy engagement, where appropriate [*Recommendation 5.2-A*].

Mobilizing data for insight – At this stage of the Africa RISING program, ensuring completeness of monitoring data and harnessing these data toward evaluation is an increasingly compelling priority. Program leaders should amplify commitments to monitoring and evaluation [*Recommendation 2.3-A*] while assessing and adjusting the integration of M&E Team activities with other program functions [*Recommendation 1.4-C*]. To support analyses using the Sustainable Intensification Assessment Framework (SIAF) and to better quantify the potential of AR-validated technologies for enhancing household income and reducing hunger and poverty, the Review Team recommends leveraging existing data streams [*Recommendation 4.4-C*] for preliminary impact assessments of key technologies, while also committing to any other necessary data collection to address key gaps [*Recommendation 4.6-B*]. The Review Team suggests special attention be directed toward promoting consistent use of strategies and tools for tracking all three types of Africa RISING beneficiaries (i.e. direct, indirect, and those reached through scaling activities) [*Recommendation 2.3-B*], while also re-assessing and learning from beneficiary target-setting [*Recommendation 3.2-D*].

Shifting focus to synthesis and gap-filling – In the remaining years of the Africa RISING program, there are opportunities to adjust program guidance and processes to better pursue highest priority program outcomes and impacts. The Review Team encourages the Program Coordination Team to clarify upcoming research priorities that correspond to program-level research questions [*Recommendation 4.1-A*] and work with regional project leaders to align research proposal solicitation / evaluation processes and selection criteria (as well as future planning) to strengthen focus on Economic, Environmental, Social, and Human dimensions to achieve more balanced emphasis across the five program outcomes. [*Recommendation 1.1-A*].

Given low uptake, a reassessment of the mandate and use cases for farmer typologies is suggested [*Recommendation 3.2-C*] along with better articulation of the actual and potential roles of women farmers in project reporting [*Recommendation 4.5-A*] and continuation and enrichment of direct farmer engagement in prioritizing challenges and selecting preferred technologies [*Recommendation 4.4-A*]. For research and development partnerships and direct engagement sites, the Review Team recommends revisiting capacity building and backstopping requirements and developing exit strategies [*Recommendation 4.7-B*].

Beyond Africa RISING

The Review Team's recommendations are informed by the larger context for USAID and the CGIAR, including shifting imperatives for research-for-development programs. In the transition to One CGIAR, there will be many different ideas and demands regarding research priorities[2] and new system-wide guidance will emerge (e.g. key project areas for the new 2030 CGIAR Research Strategy).[3] Transitions within the CGIAR are occurring in a global context in which climate change mitigation and sustainable development agendas are intensifying

[2] For example, see diverse views in a Food Policy special issue https://www.sciencedirect.com/journal/food-policy/vol/91/suppl/C
[3] https://storage.googleapis.com/cgiarorg/2020/01/SMB16-03a_Initial-Steps-and-Transition-Support-to-One-CGIAR-v3-WEBSITE.pdf

their focus on food system transformation,[4] and triggering the attention of a broader set of actors in business and finance.

In light of low historic adoption rates of smallholder-focused technology packages,[5] agricultural research institutions are encouraged to shift focus from novel inventions to innovation in practice at scales that expand socio-economic value.[6] The CGIAR is improving its capacity to evaluate adoption rates (e.g. under different incentives[7] and targeting strategies[8]) through new frameworks using existing data,[9] to develop longitudinal data resources,[10] and to quantify key types of AR4D impacts[11] and rates of return on research investment.[12] At the same time, progress is being made toward globally relevant indicators of food system sustainability.[13]

Africa RISING has built substantial expertise in technology-centered innovation, with special emphasis on integration across multiple CG centers,[14] and direct engagement with farmers and research and development partners in long-term sites, focused on short-, medium-, and potentially long-term impacts.[15] In Phase II, the AR program is gaining valuable experience through a diverse set of scaling partnerships aiming toward meaningful improvement in smallholders' income and food and nutritional security. Phase II is also seeing experimentation with new approaches and tools (e.g. tradeoff analysis; GIS; gender analysis; farmer typologies), which will need further testing and validation to understand their suitability for enabling impact at multiple scales.

In this context, the Review Team strongly encourages AR program leaders and researchers to see themselves as incubating new modes of research and development partnership and to embrace the opportunity to synthesize the diverse body of work. Donors will particularly value insights related to scaling (e.g. factors driving technology adoption; differentiated benefits and beneficiaries) and effective investments (e.g. coordinated support to research and development organizations). By re-directing AR project budgets and research priorities toward synthesis, the AR program would be well-positioned to inform the next phase of research-for-development programs.[16]

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[4] For example, see WRI. 2019. Creating a sustainable food future: a menu of solutions to feed nearly 10 billion people by 2050. Washington, DC: World Resources Institute; and FOLU. 2019. Growing Better: Ten Critical Transitions to Transform Food and Land Use.
[5] For example, 1% to 10% for NRM (Stevenson JR, Vlek P. 2018. Assessing the Adoption and Diffusion of Natural Resource Management Practices: Synthesis of a New Set of Empirical Studies. Rome: Independent Science and Partnership Council ISPC.)
[6] Hall A, Dijkman J. 2019. Public Agricultural Research in an Era of Transformation: The Challenge of Agri-Food System Innovation. Rome and Canberra: CGIAR Independent Science and Partnership Council (ISPC) Secretariat and CSIRO, IX + 67 pp.
[7] ISPC. 2019. How can Small-scale Farmers in Niger be Encouraged to Adopt Rainwater Harvesting? Results from a Pilot Study, Brief N. 74. Rome: Independent Science and Partnership Council.
[8] ISPC. 2019. Do Tailored Input Recommendations and Flexible Subsidies Increase Uptake and Yields among Maize Farmers in Mexico? Brief N. 75. Rome: Independent Science and Partnership Council.
[9] Kosmowski F, Ilukor J, Johnson N, et al. 2019. A Country-Level Approach for Tracking the Diffusion of Agricultural Innovations in Developing Countries. SPIA Technical Note No. 7. Rome: Independent Science and Partnership Council (ISPC).
[10] Elven S, Krishnan L. 2018. Estimating Historical CGIAR Research Investments, Technical Note N. 5. Rome: Independent Science and Partnership Council.
[11] Bernstein J, Johnson N, Arslan A. 2019. Meta-evidence review on the Impacts of investments in agricultural and rural development on Sustainable Development Goals 1 and 2. IFAD Research Series 38. Rome: IFAD. and Gollin, D., Probst, L. T., & Brower, E. 2018. Assessing Poverty Impacts of Agricultural Research: Methods and Challenges for CGIAR. Rome: Independent Science and Partnership Council (ISPC).Griscom B, Adams J, Ellis PW, et al. 2017. Natural Climate Solutions. Proceedings of the National Academy of Sciences of the United Nations (PNAS). 114: 11645-11650.
[12] Stevenson J, Johnson N, Macours K. 2018. Estimating ex post Impacts and Rates of Return to International Agricultural Research for Development. SPIA Technical Note N. 6. Rome: Independent Science and Partnership Council.
[13] Béné C, Prager SD, Achicanoy HAE, et al. 2019. Global map and indicators of food system sustainability. Sci Data, 6:279.
[14] A key motivation for USAID in funding AR was to see how well multiple CG Centres and development partners would function to deliver research-based technologies that enhanced the income and nutritional status of small-holder farms in SSA.
[15] Understanding how well multiple CG centers and in-region research and development partners would function to deliver research-based technologies that enhanced the income and nutritional status of small-holder farms in SSA was an important motivation for USAID in funding the AR program.
[16] Rosenstock TS, Lamanna C, Namoi N, Arslan A, Richards M. 2019. What Is the Evidence Base for Climate-Smart Agriculture in East and Southern Africa? A Systematic Map. In Rosenstock TS, Nowak A, Girvetz E, Eds. 2019. The Climate-Smart Agriculture Papers: Investigating the Business of a Productive, Resilient and Low Emission Future. Cham, Switzerland: Springer.

Introduction

Africa RISING

Africa RISING's primary objective is to identify and validate scalable options for sustainable intensification of key African cereal-based farming systems. Its overarching purpose is to create opportunities for smallholder farm households to move out of hunger and poverty through sustainably intensified farming systems that improve food, nutrition, and income security, particularly for women and children, and conserve or enhance the natural resource base. It is a ten-year, two-phase research program that was launched in 2012 and is comprised of three regional projects:

- Africa RISING: West Africa – led by the International Institute of Tropical Agriculture (IITA) this project includes activities in Mali and Ghana;
- Africa RISING: Ethiopian Highlands – led by the International Livestock Research Institute (ILRI);
- Africa RISING: East and Southern Africa – led by IITA, this project includes activities in Tanzania and Malawi and a component project in Zambia added in 2013.[17]

Africa RISING brings together a wide range of research and development partners – from the CGIAR, the national agricultural research and extension systems, higher learning institutions, farmers, policy makers, and agrodealers and other private entrepreneurs – to develop management practices and technology combinations to better integrate crops (cereals, legumes, fruits and vegetables), livestock (including poultry), trees, and shrubs in mixed-farming systems with the aim of improving whole-farm productivity, nutrition, and incomes of small-farm families without degrading the environment. It also develops innovations that effectively link farmers to markets and input suppliers.

Phase II

Phase II of the AR program (2016 to 2021) is intended to achieve tangible outcomes in five domains of sustainable intensification:[18]

- Program outcome 1: Productivity – Interventions targeting the productivity domain seek to promote directly the intensification part of sustainable intensification with impacts on food security and income;
- Program outcome 2: Economic – Research in the economic domain focuses on factor productivity and the value chain function with the ultimate aim of impacting on poverty levels and prevalence;
- Program outcome 3: Environmental – Research in this domain needs to identify unintended environmental consequences of innovations promoting productivity and economic wellbeing (in particular), as well as landscape scale interventions to support SI. Targeted impacts include more stable and resilient production, and the mitigation of environmental damage.
- Program outcome 4: Social – Research outcomes in this domain include strengthening social capital, and identifying and supporting opportunities for collective action to impact beneficially on social cohesion;
- Program outcome 5: Human – Major elements of the human domain for Africa RISING are the health and nutrition outcomes generated along SI trajectories. These may be targeted both directly and indirectly on the general wellbeing and capacity of individual beneficiaries.

Phase II continues action research from Phase I to identify, test, and validate interventions and innovations that promote sustainable intensification and its benefits across these domains for a variety of stakeholders.[19] In addition, Phase II forges Research in Development partnerships to facilitate scaling of Africa RISING associated technologies (i.e. the outputs of Phase I).

[17] Zambia was not included in this evaluation.

[18] These correspond to the CGIAR's System Level Outcomes (SLOs).

[19] In AR-ESA, researchers seek interventions that can help smallholders and farm communities to (i) increase productivity per unit land, labor, and capital; (ii) use farm inputs efficiently; (iii) conserve / enhance natural resources; and (iv) increase resilience and reduce risk at household, farm, and landscape levels. A validated intervention will demonstrate improvement for at least two SI domains with no obvious negative impacts in the other SI domains.

Performance evaluation: purpose and process

The performance evaluation is intended to provide Africa RISING's implementers with constructive feedback on critical aspects of progress made towards envisaged objectives and outcomes. The Review Team used a mixed-methods approach that included:

- **Document review:** of relevant program / project documents and materials, including those produced by local and core CGIAR partners (e.g. baseline data, research protocols, data analysis documents), since the start of Phase II of the program (see Appendix 1);
- **Key Informant Interviews (KIIs):** with 48 individuals including Africa RISING researchers, management and governance staff, implementing center leaders, USAID partners in Washington and Missions in program countries, and research and development partners (see Appendix 2);
- **Focus Group Discussions:** semi-structured discussions with program partners and farmers' groups that have engaged with the program (see Appendix 3);
- **Stakeholder Analysis:** to determine the effectiveness of partnerships and institutional collaboration between the lead institutions of Africa RISING (ILRI, IITA, IFPRI) and partners;
- **Field visits:** to 28 project sites across Ghana, Mali, Ethiopia, Malawi, and Tanzania.[20]

	July-Aug 2019	Sept-Nov 2019	Jan-Feb 2020	Mar-Apr 2020
Focus	Familiarization with program, 3 regions	In-depth review of WA, ET regions	In-depth review of ESA region	Analysis of whole program
Methods	Methods: Document review, KIIs	Methods: Field visits, FGDs, Stakeholder analysis (as needed, KIIs)	Methods: KIIs, Field visits, FGDs, Stakeholder analysis	Methods: KIIs, Field visits, FGDs, Stakeholder analysis
Outputs	Methods, Templates, KII summaries	Interim report for WA, ET	Debriefing summary	Draft final report; Final report

The Review Team undertook its work through collaborative allocation of responsibilities (e.g. reviewing documents; conducting KIIs). Regular cycles of review and team discussion were used in the development of evaluation tools and protocols (e.g. for KIIs, FGDs, and field visits) and in determining priority recommendations. Structured rounds of drafting and review, including feedback from AR program leaders, guided production of the Interim (submitted in November 2019) and Final Reports. All reasonable attempts were made to ensure a comprehensive performance evaluation, although inevitably the Review Team could not investigate every aspect of the AR program, given its complexity and the variety of sites, partnerships, and technologies.

Using an evidence-based and data-driven approach, this review evaluates five programmatic areas (detailed discussion of each is presented in the sections below):

1. Organizational structure
2. Data Management, Monitoring, Evaluation and Learning
3. Research and Development partnerships
4. Research achievements
5. Program Alignment with donor and country development strategies

[20] These included: Ghana (Nyangua in Upper East region; Tibali, Duko, Kpatarrbogu, and Tingoli in Northern region; Novrongo district), Mali (ICRISAT and IER-Sotuba research stations; Madina and Flola in Bougouni region; M'Pessoba, Sirakele, and N'golonianasso in Koutiala region), Ethiopia (Tsibet, Emba-hasti, and Ayba in Maichew region; Jawe and Upper Gana in Hossana region), Malawi (Linthipe, Ntubwi, Nsanama, Lemu, Zomba), and Tanzania (Mlali and Laikala in Dodoma region; Sabilo and Lukmay farm in Babati region; Rhotia Khainam in Karatu region).

1. Organizational structure

This section describes findings regarding the organizational structure of the AR program and identifies gaps, weaknesses, and proposed solutions. Inaugurated in late 2011, and currently in Phase II (since October 2016), the AR program's focus is on sustainable intensification (SI) of production from small-scale, crop–livestock farming systems, through integrated multidisciplinary research to deliver a basket of technological innovations that are being disseminated to farmers through complementary development partnerships. A central premise of the AR program is that project-created innovations fit within specific contexts, which determines their potential for impact.

Structure and processes

1.1 Is the structure conducive to achieve program level outputs, outcomes and impact?

Context. The Phase II proposal outlines three types of methodological and diagnostic research: typologies for farmer targeting, systems analysis, and tradeoff analysis.[21] Research is meant to generate evidence on five program outcomes – Productivity, Economic, Environmental, Social, and Human[22] – which are intended to lead to desired impacts of enhanced household income and nutrition, especially the nutrition of women and children. The Social outcome focus is on social capital and collective action, while the Human outcome's focus is on health and nutrition. The proposal also notes that Phase II offers the opportunity for projects to undertake research on scaling technologies for widespread benefits.

Recommendation 1.1-A. **AR governance mechanisms should actively guide research proposal solicitation and evaluation processes and selection criteria to re-balance emphasis across the five program outcomes.** (See Section 1.2-C, 4.4-B, 4.4-D)

Observations. Overseen by regional project leaders, funding decisions for researcher-submitted sub-activity protocols / proposals have a profound impact on implementation of the AR program. Selection of research protocols determines the types of outputs, outcomes, and impacts that are possible for a regional AR project to achieve. Project leaders have clarified that proposal quality is a necessary and key criterion, and have also mentioned the need to meet AR program objectives. However, review of the three AR regional project workplans (for 2018-2019) indicates that the majority of funded proposals are focused on Productivity, with much less focus on Economic, Environmental, Human, and especially Social outcomes.

As it did not receive AR documentation on the allocation of research activity or resources across the five program outcomes, the Review Team undertook a preliminary analysis (see Appendix 4).

- Of the 31 sub-activities undertaken in WA according to the 2018-2019 workplan, the primary objectives of 17 sub-activities are productivity-related, 5 are economics-related, 3 are environment-related, none are related to social capital or collective action, 5 are human-related, and 1 specifically addresses scaling. Additionally, 14 sub-activities include some research activities concerning the cross-cutting theme of gender, while 3 address nutrition, and 1 explicitly addresses youth. Many research activities also have secondary objectives covering additional program outcomes; these include 7 productivity, 7 economic, 4 environmental, none for social capital/collective action, 1 human, and 1 scaling-related.
- For Ethiopia, the 2018 Workplan and AR projects-protocols summary for 2019 and mid 2020 contain information on 12 sub-activities of which 7 are primarily productivity-related, 2 are primarily environment-related, 2 are primarily scaling-related, and one is primarily human (nutrition)-related. None of the sub-activities are primarily economic- or social-related, though 3 of the 12 have some work related to economics, and one has some work that can be considered related to social (i.e. multi-stakeholder innovation platforms).
- Of the 45 sub-activities undertaken in Malawi and Tanzania, according to the 2018-2019 ESA workplan, the primary objectives of 25 sub-activities are productivity-related, 3 are economics-related, 2 are

[21] Derived from the 'Core Principles' section of the Phase II program proposal document.
[22] These five program outcomes correspond to the five domains of the SIAF.

environment-related, 2 are related to social capital or collective action, 4 are human-related, and 10 specifically addresses scaling. Additionally, 29 sub-activities include some research activities concerning the cross-cutting theme of gender, while 5 address nutrition, and 2 explicitly address youth.

Most of the economic-related activities are cost-benefit analysis with limited information reported on the range of costs and benefits obtained by different types of farmers. Additionally, the Review Team encountered few value chain analyses with just two studies explicitly aimed at understanding the role of market institutions in promoting the uptake of AR-generated innovations. The use of tradeoff analysis to help identify likely bottlenecks in adoption by specific farm and / or farmer types, and options to address these, is also quite limited; at least some information on the latter is likely to be provided by upcoming SI adoption studies (see Section 4.4-D).

In attempting to document how well the three types of diagnostic and methodological tools (i.e. typology-based targeting; systems analysis; tradeoff analysis) underpin AR activities, limited information was discovered for at least some funded activities.[23] For example, of the 88 sub-activities across the three regions (Appendix 4), only 5 use typologies, though 12 sub-activities incorporate some aspects of equity, primarily through eliciting gender preferences for different SI options. Though very difficult to tell, another 19 to 21 sub-activities have research that may be considered 'systems-level.' Just 3-4 sub-activities have research that explicitly assesses tradeoffs; however, activities with components addressing more than one dimension potentially could assess tradeoffs as well.[24]

In each region, the Chief Scientist and Project Manager have responsibility for proposal selection (based on Phase II logframes). In practice, pressure to make timely decisions (i.e. so activities can proceed to implementation) makes it difficult to filter submitted proposals for balance across domains.[25] In some years, proposals have been approved on a rolling basis (i.e. so that on-time submitters are not delayed by late-submitters).

Rationale. There is a clear need to identify and fill research gaps that will otherwise prevent the AR program from effectively addressing the full set of program research questions (see Section 4.1-A) and reaching intended program outcomes and impacts. AR program and project leaders should integrate their collective knowledge about how research activities and funding allocations correspond to the five program outcomes.[26] This should illuminate priorities for achieving a more balanced allocation (i.e. strengthen focus on Economic, Environmental, Social, and Human dimensions) through stronger guidance of solicitation and evaluation processes and selection criteria for researcher-submitted protocols.[27] The Review Team recommends greater AR investment in the following research areas:

- Meta-analyses to estimate AR-validated technology impacts on household food security, income, and nutrition (see Section 4.2-A).
- Value chain analysis including topics such as access to markets and welfare effects of market participation,[28] with a strong emphasis on the seed supply portion of the value chain (see Section 5.2-A).

[23] Since these tools form part of the core principles of Phase II, the Review Team attempted to assess their use, recognizing that such efforts may not accurately reflect project tools.
[24] Outputs in the ESA Phase II Workplan and Technical Reports are organized according to regional project outcomes (rather than country level). Adoption of standard methods of organizing workplans and technical reports could facilitate a more uniform monitoring and evaluation of sub-activities across the three regional projects.
[25] Neither the PCT nor the PSC has responsibility to ensuring balance across the five domains.
[26] For example, outcome analyses drawing on the RHoMIS study that looks at 27 indicators across all five domains.
[27] The specific roles of the PCT and regional PSCs in responding to this recommendation will needed be determined, noting challenges affecting PSCs (see Section 1.4-D).
[28] This would include understanding the capacity and incentives of food-insecure farmers to engage in markets. As an example, value chain analyses are underway for nutrient-dense maize seed and for groundnut seed in central Tanzania.

- Economic evaluation of SI technologies such as gross margin analysis, labor requirements, and profitability analysis,[29] with focus on farm, household, community, and landscape levels[30] as well as gender differentiation (see Section 4.5).
- Tradeoff analysis that assesses the impact of AR-generated innovations, particularly on the environment[31] and for different types of households (e.g. in different income quintiles; headed by women) (see Section 3.2-B, 4.4-B, 4.4-D).
- Farming systems research and cross-cutting gender analyses[32] (see Section 4.5, 4.6) that integrate agricultural and socio-economic dimensions to provide insights on patterns of adoption and dis-adoption.
- Research on relevant institutions that facilitate scaling (e.g. financial institutions, farmer organizations, extension systems) and on scaling modalities[33] (see Section 3.2, 4.4-D)

Recommendation 1.1-B. **AR regional projects should increase research funding and staffing related to the Economic, Environmental, Human, and especially Social outcomes.** (See Section 1.1-A, 3.1-A, 4.6-B)

Observation. Under the SIAF, the Social domain encompasses two very different things: gender / equity (i.e. individual level outcomes) and social capital / collective action (i.e. supra-household level outcomes related to farmer organizations, women's and youth groups, and community-based NRM structures). The table in Appendix 4 considers gender as a cross-cutting theme, as presented in the Phase II proposal. While more in-depth work on gender can and should be pursued (see Section 4.5-A), project leaders have indicated that gender specialists are currently working with AR to ensure these issues are adequately addressed. Research on social capital and collective action could be of significant importance in scaling up activities and could also inform targeting. However, the AR regional projects have not undertaken much work on social capital or collective action[34] and have conducted only limited work on value chains that might potentially uncover information on related institutions (e.g. farmers' organizations).[35]

The AR program emphasizes pathways out of hunger and poverty for smallholder farm families with a focus on improved food, nutrition, and income security, particularly for women and children. Yet, across the AR program, funding has heavily supported researchers specializing in agronomy, plant breeding, animal science, and other production-focused areas with significant, but more variable investment in natural resource management. The few socio-economic specialists with significant AR time allocations appear to function as vectors for shared research approaches across the three regional projects. (Other socio-economic specialists have very limited AR time allocations and wide-ranging demands.) Also, the AR program seems to have a limited number of 'mixed farming systems' scientists, who focus their research beyond specific disciplines and localized processes. Stretching very limited staff across multiple regions can result in weak access of regional projects to essential expertise and excess burden on individual researchers.

[29] Topics of interest include effects of technology adoption on household income and food expenditures, net crop returns, and whole farm budgets.
[30] While some economic analysis may generate per hectare estimates of economic impact (if sufficient data are available), scaling partners could also make use of 'looser' calculations and, given their familiarity with farmers' 'real world' situations, would be valuable collaborators in further studies to refine preliminary estimates.
[31] For example, might adoption lead to expansion of land under cultivation or greater reliance on expensive and potentially environmentally hazardous agrichemicals?
[32] For example, project in Tanzania using the SIAF to generate research hypotheses and conduct research on potential / actual tradeoffs in outcomes associated with smallholder mechanization (e.g. maize shellers, feed mills, forage choppers).
[33] Including assessment of potential technology scaling partners (e.g. extension systems, projects led by other donors or CG centers, local NGOs, farmers' associations) and evidence for research-for-development pathways that are useful / in use by scaling partners and are viable for different environmental contexts and farm types within a specific location.
[34] One counter-example might be the governance work with farmer cooperatives (e.g. co-owned maize shelling equipment in Ghana; feed mills and forage choppers in Tanzania; kebele-level seed multiplication in Ethiopia) although the specific contribution of AR researchers and partners to existing social structures / institutions could be better clarified. Also, a new ET-AR protocol is reviving multi-stakeholder Innovation Platforms (see Section 4.7-A).
[35] There may be interesting opportunities to add value chain-focused research to existing productivity and environment related research (e.g. assessing household nutrition, income, and value chain effects of implementing contour bunds that not only reduce erosion and enhance cereal yields, but also improve shea nut yields).

Rationale: The AR program faces several program-level challenges: (i) Research capacity / investment that is out of balance with the AR program's multi-objective framework,[36] leading to weak attention to socio-economic domains and system-level productivity and resilience; (ii) Over-stretching of a limited number of socio-economic and 'systems' researchers. At this point in the AR program, directing resources toward research and staffing in the Social domain may not be a priority (e.g. the AR program may not be well positioned to contribute in this research area), however investing in this type of research merits discussion (i.e. to realistically assess the AR program's capacity) and a PCT-level decision. Yet, a rebalance of expertise could expand the research portfolio from its focus on innovative component technologies to more fully emphasize integrated agricultural systems, which would be better aligned with the AR program's goals. Where research partnerships can be leveraged to broaden disciplinary expertise,[37] these opportunities should be seized (see Section 3.1-F).

Figure 1. Socio-economic researchers with participating farmer in Sabilo, Tanzania

Recommendation 1.1-C. **To increase their use in research synthesis, program leaders should revisit the objectives and guidance for technical reporting.**

Observation. Regional project leaders develop semi-annual AR Technical Reports (for each of the AR regional projects) to USAID based on reports provided by AR researchers.[38] The semi-annual AR Technical Reports do not seem to adequately capture the contribution of sub-activity deliverables toward larger project outputs (which are commonly comprised of research deliverables from multiple sub-activities) and outcomes.

The Review Team compared planned research (using Project Workplans) to what has been reported (in AR Technical Reports) for WA and ESA. This analysis found several misalignments among research plans, deliverables, sub-activities, and project outputs. When deliverables are properly included, technical reporting may provide an important additional M&E tool. A challenge highlighted by AR activity leaders is that the semi-annual AR Technical Reports may not capture important scientific and operational information that is included in the reports produced by research leaders.

The Review Team also found that components of some Technical Reports, notably tables and graphics, do not function as stand-alone summaries of research results and the degree of detail varies dramatically. For a table

[36] Program leaders noted challenges in recruiting social scientists and farming systems specialists.
[37] This could occur within CG partnerships as well as with non-CG research institutions. Note that blending an academic focus with practical information needs would be beneficial for increasing the AR program's impact. (See Section 4.5)
[38] These Technical Reports to USAID are based on semi-annual reporting by activity leaders, typically an interim progress report in April and a full report with data September. These activity leader reports are uploaded to the IITA internal database.

or figure[39] to be a stand-alone summary of research results, it needs to contain all necessary information (often as footnotes) to remind readers of key experimental details, such as treatment structure, key methods, measurements, etc. (For an illustration of some of the scientific improvements that can be made to AR Technical Reports, see Appendix 5.)

Report templates used by AR field staff are designed to enumerate and describe the major project activities, results, outputs, problems / challenges encountered, and solutions applied. The Review Team heard a range of comments that suggest the need for more consistent completion of report templates[40] and, in some cases, field checks of implemented research (e.g. to see how an AR technology is working in practice; to provide constructive feedback to field staff).

Rationale. As discussed in Section 2.4, research synthesis is an area for increased effort. As one potential resource, AR program and project leaders could make better use of the technical reporting process to inform research synthesis, as well as support discussions at annual planning meetings, development of technical bulletins, and 'storytelling' (see Section 2.4). Revised guidance for technical reporting, paired with research-sharing strategies,[41] could seek to ensure:

- Shared understanding of the level of detail and types of information necessary for each level of reporting (i.e. sub-activity reports, Quarterly Technical Reports, AR Technical Reports).
- Consistency across researcher-submitted technical reports (i.e. revised templates that are better suited for tracking sub-activities against outcomes, summarizing key results, and synthesizing project findings).
- Better linkages within the semi-annual AR Technical Reports to the detailed researcher-submitted reports that are their technical underpinning.[42]
- Sufficient detail in semi-annual Technical Reports to clearly demonstrate how deliverables from research sub-activities are making progress toward AR project outputs and outcomes (i.e. a reader should be able to confirm assertions of progress toward outcomes through the text, appendices, or embedded linkages in an AR Technical Report).[43]

1.2 What effective processes are in place for cross-project harmonization and how might harmonization be strengthened?

Context. USAID is very interested to see the AR program produce generic, transferable innovations for smallholder mixed crop-livestock systems that integrate commonalities across different cultures and geographies. In Phase I, the research structures of the three regional projects were established independently. This inhibited identification of common elements and program-wide harmonization of hypotheses and protocols. In Phase II, the AR program was intended to maximize shared learning and wider dissemination of research outputs through cross-project harmonization in data collection, structured collaborations, common frameworks for M&E, and assessing progress toward sustainable intensification (i.e. "a program with 3 legs"). The AR program was specifically asked to address program-wide harmonization, and there have been notable efforts, such as:

1. Program-wide Communities of Practice (CoP) designed to exchange ideas and results from research (e.g. on nutrition, livestock, soil and water management, scaling, gender, data management, communications and capacity development) in response to similar constraints in smallholder farming systems and to connect and capitalize on expertise and knowledge across countries.[44]

[39] For example, each SIAF radar plot should be accompanied with a footnote containing a list of indicators that have been monitored / evaluated within each domain.
[40] AR program leaders noted that the quality of reporting using templates is mixed (e.g. errors, typos) and therefore these reports are not uploaded publicly (reports to USAID undergo a full editing process). Receptivity to feedback on reporting has been low.
[41] For example, producing a compendium of technical reports as they come in from research leaders.
[42] For example, sections of research-submitted reports that focus on sub-activities, deliverables, and achievements could be collated.
[43] Regional project leaders noted that integrating findings across research activities is also a priority.
[44] For example, the CIMMYT evaluation of maize varieties was meant to look at impact on all 5 dimensions and community of practice scientists would advise on how to look at the different dimensions (i.e. not just ask the maize breeders to account for all dimensions on their own). There is an effort now to set up sustainable intensification dimension specialists ("guardians").

2. An annual science event to bring researchers from across the three regional projects together to showcase their work, discuss potential collaborations, and develop commitments for aligning activities (e.g. standardized agronomy trial design).[45]
3. Structured interactions among researchers (e.g. Chief Scientists), scientific field trips and exchanges, and cross-regional invitations to attend regional annual planning and review meetings.
4. Common data-gathering (e.g. ARBES) and shared tools (e.g. SIAF; BTTT; PMMT).
5. Collaborative efforts to build cross-regional awareness of AR activities (e.g. cross-fertilization between AR communications, the IITA Bulletin, and ICRISAT's weekly newsletter).

Despite evident attempts to promote cross-regional interaction and harmonization, these have produced modest results (e.g. described by some as a 'work in progress'). Several people noted that the AR Ethiopian Highlands project operates particularly independently, although AR-ET leaders point to participation in cross-regional project visits, learning events, and review and planning meetings. Participation in CoPs was reported as 'limited' and these were discontinued in the context of budgetary constraints. Delivery against commitments made at annual science events has been low. In addition to budget challenges, barriers include:

- Inherent differences in the regional contexts and capacities of the three AR projects result in different approaches (in response to specific conditions) and potential for impact.
- Competition with researcher's other priorities – including nurturing in-country partnerships with other researchers (e.g. other CGIAR centers, NARS, universities) and development organizations – in a context of chronic time limitations (i.e. few researchers have a majority of their time allocated to AR).
- Regional projects are led by different CGIAR centers, with their own institutional mandates, imperatives, and approaches, and cross-regional interactions are voluntary.
- Few budgetary incentives for cross-regional collaboration and reduction in available budget for cross-regional interactions (e.g. CoP meetings ended).

Recommendation 1.2-A. **Program leaders should target cross-project harmonization efforts toward highest potential outcomes.** (See Section 1.1-A, 2.4-A)

Observations: Originally developed as three separate projects, the Phase II mandate for harmonization (i.e. common approaches; high-level analyses) across these different regions was hampered by pre-existing project-level operational structures and research approaches and a perception of harmonization as a top-down approach.[46]

Rationale: Rather than calling for redoubled efforts toward cross-project harmonization efforts, it may be appropriate for program leaders to develop more realistic expectations about when and how harmonization is likely to produce meaningful results that serve high-priority program objectives. AR Program leaders could initiate a process to delineate the highest priorities such as better integrating research approaches for specific technology categories such as animal feeding and small-scale mechanization (see Section 3.3-A); promoting harmonized approaches to SIAF application (see Section 4.6-A); and engaging global donors and African policy leaders around solutions to systemic challenges such as seed system bottlenecks (see Section 5.2-A).

Recommendation 1.2-B. **Promote cross-regional collaborations through the annual program-wide science event and new incentives for follow-through.** (See 1.1-A)

O*bservations*: Project and program level convenings, such as the annual program-wide science meetings and other learning events, are useful venues for promoting cross-regional harmonization, however more deliberate meeting structures could be useful. For example, meeting sessions could preclude basic presentations of individual researchers' work in favor of synthetic, jointly-presented material that showcases alignment among research activities in different regions or explores integrated analysis (see Section 4.2-A).

[45] In Ghana, AR researchers noted the usefulness of one-day learning workshops with partners, held during Phase I, to share results and ideas, to jump-start data analyses, and to identify possible additional partners.
[46] An additional barrier may be a limited number of AR-affiliated researchers with interest / capacity for synthesis and writing.

Rationale: Researcher-level barriers to follow-through on cross-regional collaborations could be offset through a combination of support and incentives. The annual cross-regional science event merits continued investment as a venue for promoting multi-year continuity in researcher networks, reinforcing program-wide approaches and principles, and providing visibility (and accountability) for cross-regional collaborations. In between annual events, the Communications Team can amplify attention to these collaborations (e.g. cross-fertilization with communication units of participating CGIAR centers and other partners).

New 'rewards' for delivery against planned cross-regional collaborations could incentivize researchers to make these activities a higher priority. Such rewards could be developed in consultation with a representative set of AR researchers to understand meaningful reward criteria and forms of support. Rewards could take the form of performance-based research top-up funds, support for conference participation (e.g. registration, travel), or resources for a deliverables-oriented cross-regional design or writing workshop. It may be appropriate for rewards to be modular with each new funding increment contingent on achieving collaboration milestones.

1.3 The regional projects are applying differential operational arrangements. Are there valid reasons supporting a shift of Africa RISING to a more common approach?

Context. The AR program was initiated in 2012 and is scheduled to close in 2021. Originally designed as three linked regional projects, in Phase II, Africa RISING was re-conceived as an integrated, multi-region program.

Recommendation 1.3-A. **The PCT should continue to promote harmonized operational arrangements to ensure program-wide delivery of outputs, outcomes and impacts**. (See Section 1.1-A, 1.1-C, 1.2-A)

Observation. At this stage, there do not seem to be strong reasons to shift to a more common operational arrangement. It does not seem likely that any one person could function as the lead to ensure common operational arrangements in any case, given that there are three lead CG centers.

Rationale. Instead, structure changes suggested in Sections 1.1-A, 1.1-C, and 1.2-A could usefully be adopted to fully exploit cross-project learning and the development and dissemination of generalizable evidence.

Effectiveness of program roles

1.4 Are the various program level entities (PCT, Comms, M&E) effective in fulfilling their roles?

Program Coordination Team

Context. The AR Program has no management entity for centralized decision making. The Program Coordination Team (PCT) is mandated with providing technical and managerial advice and coordination across the three regional projects (including for M&E) to ensure a common understanding of sustainable intensification and its potential contribution to Feed The Future (FtF) goals. The Terms of Reference for the PCT include: (i) interface with the donor for the program and regional projects; (ii) track project reports and provide feedback and advice to the individual project management teams; (iii) provide support for coordination and integration, but not supervision, across projects; (iv) convene, sponsor, and approve the research approach design process; (v) set standards and guidelines, approve objectives / outcomes, etc.; (vi) facilitate good communication and learning; (vii) advise on Communications and M&E teams' work plans; (viii) determine the focus of an annual program-wide learning meeting; (ix) promote coordination, alignment, and integration with related research projects; and (x) meet annually face-to-face and virtually as required. The AR Communications Team leader plays an administrative role and reports on PCT meetings on the program website.

It appears that the PCT has been effective in fulfilling its roles and operating in a professional and transparent manner, despite encountering challenges, such as:

- Program structure in which regional project managers have final decision making power (i.e. no program-wide authority), requiring the PCT to operate on a consensus basis.

- Budget crises that put substantial strain on AR partnerships, regional projects, scientists and field staff, and M&E activities, requiring the PCT to make tough decisions (e.g. discontinuing the CoPs and Scientific Advisory Group).
- Inconsistent alignment among regional projects and data management, evaluation, and impact assessment components.[47]

Recommendation 1.4-A. **Continue effective operation of the Program Coordination Team and consider developing more explicit protocols for achieving compromise in the absence of consensus.**

Observations: Not all program-level conflicts can be effectively managed in the absence of program-wide decision making authority or guidance. The AR Program has encountered cases where disagreements between CGIAR partners on implementation strategy were not successfully reconciled.

Rationale: While imposition of a central authority is unlikely to be a feasible option at this point in the AR program's trajectory (see Section 1.3-A), the PCT could benefit from more structured mechanisms for promoting compromise when program and project leaders are in disagreement. Such mechanisms could take the form of bespoke PCT protocols, derived from its own experience and insight into likely areas of friction.

Communications Team

Context. The Terms of Reference for the Communications Team specifies that it will: (i) lead public relations and outward facing communications; (ii) provide a coordinated and consistent communications approach / strategy across the regional projects and publicly on behalf of the program; (iii) manage the program website and collaborative spaces with document repository and associated platforms; (iv) produce program communication products for different audiences; (v) build and maintain productive relationships with USAID FtF and other related communication initiatives; (vi) ensure, as far as possible, that outputs from the program are documented, published, and made widely accessible; (vii) ensure compatibility with USAID and CGIAR communications guidance and establish consistent branding for the program and projects; (viii) support the PCT and the annual program learning event (and other cross-project learning as demanded); (ix) on demand, provide facilitation services for all program and major project meetings; (x) draw in communications expertise from partners; (xi) promote the effective use of knowledge, communication, and ICT within the projects; (xi) provide email / hard copy communication when required for program and project partners without adequate web access; and (xii) facilitate peer-to-peer learning.

At this point in the AR program's history, the Communications Team appears to be functioning well with clear staffing and oversight roles for communications and knowledge management, despite encountering challenges such as:

- Geographically dispersed communications staff based in different home institutions (e.g. IITA, ILRI), which can impede efficient implementation and blur roles, and staffing gaps due to program budget crises.
- Numerous potential audiences and stakeholder groups ranging from internal constituencies (e.g. PCT, AR researchers and partners) to targeted beneficiaries (i.e. rural farmers) to program donors (e.g. USAID Bureau for Resilience and Food Security, BRFS, and country Missions).
- A wide range of communication topics spanning the five domains, scientific findings, implications for policy and business communities, impact assessments, farm-level decision making and tradeoffs, technology ROI, landscape-level considerations, etc.
- Interest to utilize multiple types of communication modes (e.g. radio,[48] web presence, gender-differentiated communication products, briefing papers, infographics, digital extension and other innovative ICT) including event coordination (e.g. scientific exchanges).

[47] For example, different approaches between the evaluation team and project implementers resulted in disruption of an impact assessment in Tanzania.

[48] For example, a 2017 partnership in Mali with Farm Radio International to a month-long serialized program touching on different AR technologies (using local languages) was very positively received.

The Communications Team has prioritized three types of audiences:

- Primary audiences: USAID (specifically BRFS, country Missions, and relevant offices to the AR grant), farmers (in project intervention communities and beyond), scaling partners, the PCT, regional Project Steering Committees, and research partners (in CGIAR centers, NARs, and international research institutions).
- Secondary audiences: Journalists, bloggers, and science communicators.
- Tertiary audiences: Potential donors, the CG Maize and Livestock CRPs, and 'sister' projects working on sustainable intensification of smallholder agriculture / systems research in agriculture (e.g., Feed the Future Innovation Labs, SIMLESA, and CSISA).

Recommendation 1.4-B. **Extend workplan-based prioritization and program-level integration of the communications function.** (See Section 1.2-B, 2.1-A, 3.1-C, 5.1-A)

Observations: Under the 2019-2021 program-wide communications strategy, each regional project communication specialist develops an annual workplan that is reviewed by the AR Program Communication and Knowledge Sharing Coordinator. The Communications Team organizes the AR annual science event, which brings regional partners together to improve mutual awareness and cross-fertilization, and it has produced some well-timed synthesis reports.[49] In addition to responding to USAID requests for communication materials and supporting researcher-led outreach, the Communications Team has also supported engagement of USAID Missions (a challenging audience given their high staff turnover), which have provided important complementary funding.

Rationale: To manage wide-ranging demands and competing priorities, the Communications Team is well-served by adhering to clearly defined workplans and priority audiences and further leveraging its connectivity to the communication units at CGIAR centers (and other partners). Greater visibility of the AR program's strategic vision, impact on policy, and scaling efforts can be pursued by focusing on cross-regional synergies and collaborations with relevant external projects.[50]

Monitoring and Evaluation Team

Context. Led by the International Food Policy Research Institute (IFPRI), whose staff are primarily based in Washington, DC, and supported by regional M&E officers, the Monitoring and Evaluation (M&E) Team coordinates across the three regional projects and has a separate budget for data management, M&E activities, and M&E reporting to the donor. The M&E Team is charged with undertaking: (i) farming systems, typology, livelihood, and poverty characterization analysis; (ii) *ex ante* and *ex post* evaluation of AR innovations; (iii) follow-up evaluation surveys to conduct relevant applied research using panel data identification strategies; and (iv) targeted case studies and experiments to guide new research streams.

For Phase II, a decision was made to devolve monitoring responsibilities to the regional projects, and IFPRI allocated funds for monitoring to WA, ET, and ESA. There is currently a monitoring specialist for WA based in Ghana (who has weekly calls with DC-based IFPRI staff) and recruitment is underway for monitoring specialists for ESA and ET.[51] The key responsibilities for project monitoring lie with the regional projects, which are generating data for FtF indicators and beneficiary tracking.[52] Work is on-going to develop scaling partner beneficiary tracking tools.

[49] The 2017 "Footprints" report, which presented anecdotes of AR Phase I accomplishments, coincided with publication of annual reports by lead CG centers (ILRI, IITA) enabling comparison of impact metrics and program achievements.
[50] Footprints of Africa RISING, 2018.
[51] The AR-ET project is currently devoting 0.5 FTE; over the last two years, released funds only covered three months of staff time. AR program leaders noted challenges in hiring and retaining regional M&E staff.
[52] The expectation is that FtF-related data will be collected by each researcher, supported by an M&E data manager, who will cross-check, collate, and aggregate these data prior to integration into the M&E team performance narrative. The online project mapping and monitoring tool (PMMT) was developed to facilitate FtF data collection by authorized individuals.

Recommendation 1.4-C. **The PCT should assess the effectiveness of the M&E Team's integration with other AR program functions and identify / implement course corrections.** (See Section 2.3-A)

Observations: The Review Team encountered strong signals from across the AR program that the M&E function was not well-integrated with other program components. Some specific challenges were noted:

- Limited in-region M&E staffing or field presence (strongly linked to budgetary uncertainties) creating delays in data collection in some AR countries;[53]
- M&E tools that were perceived as difficult to populate and low participation by researchers in data-sharing mechanisms;[54]
- Low productivity on the program-wide learning function (see Section 2.4-A).

Across the duration of the AR program, misaligned expectations appear to have persisted among the three lead CG centers. IFPRI has sought to inform USAID and the international community about programmatic progress and successes, but struggled to apply a consistent impact evaluation methodology to a bottom-up, evolutionary research program with highly diverse technologies and approaches (e.g. different technologies tested on different farms).[55] Funding uncertainty inhibited pursuit of new forms of collaboration to address misalignment.[56]

Rationale: The M&E function is essential to documenting and increasing the impact of the AR program (i.e. evaluation of AR innovations; informing scaling activities; highlighting potential new research directions) as well as to 'gatekeeping' for institutional data management. In its current form, the full set of M&E functions do not appear to be consistently delivered (see Section 2.3 and 2.4). For example, there appear to be gaps in use of monitoring data for effective project management and enhancing program-wide learning as well as up-to-date tracking of progress toward research outcomes and impact on indirect and scaling beneficiaries. The recommendation to identify and implement course corrections relates to all M&E Team functions (i.e. devolved monitoring responsibilities; IFPRI-led evaluation and learning). Opportunities to better support impact assessment, cross-regional harmonization, and meta-analyses should be more vigorously and creatively pursued (see Section 1.1-A, 1.2-A, 4.2-A).

Project Steering Committees

Context. A regional Project Steering Committee (PSC)[57] oversees research, budgets, work plans, M&E, and communications. A PSC's Terms of Reference include: (i) provide advice on and oversight of project activities; (ii) provide science guidance to project implementers to ensure conformity with core program principles and objectives; (iii) guide project planning and activities; (iv) approve project work plans and budget; (v) liaise with M&E Team to oversee project-level M&E, keeping PCT informed on all reporting; (vi) keep PCT informed of activities via the Project Coordinator / Manager; and (vii) review and make suggestions to the Project Coordinator/ Manager on semi-annual Technical Reports to USAID. PSCs are meant to make decisions by consensus during an annual meeting in person and occasionally as called by the chair. An external Science Advisory Group was meant to provide program-level scientific advice, however, it was discontinued in 2017 due to budget constraints. Additional science advice is sought from external project and program reviewers as well as through science meetings organized at program- and project-level to provide peer advice.

[53] For example, a third party has been hired to accelerate collection of FtF and beneficiary data in Mali.
[54] Tool development engaged tool users, who also were offered training.
[55] Ex post evaluations need to be combined with ex ante assessment of technologies to generate evidence on the expected effects of technologies if scaled up to national level or beyond. (Footprints of Africa RISING, 2018).
[56] IFPRI leaders have noted that, in Phase I, program design reflected a heavy focus on research productivity with less attention to development outcomes (e.g. resistance to investing in cost-benefit evaluation). Also, the 'quick wins' projects at the very beginning of the program set a tone of low coordination across activities. It has been difficult for this program design to adapt to USAID's Phase II mandate for demonstrated development impacts and cross-regional harmonization. More recently, IFPRI has focused its efforts on the BTTT and matching specific technologies with specific households.
[57] Ethiopia does not have a PSC and relies on the following to achieve most of the relevant functions: (i) Co-location of partners in Addis Ababa allows for frequent partner meetings; (ii) Duplication of functions with annual and regional planning meetings; and (iii) Co-location of site coordinators with regional partners.

Recommendation 1.4-D. **Candidly revisit the mandate and functioning of Project Steering Committees.** (See 1.1-A, 4.4-D)

Observations: Unlike the other program management entities, the regional Project Steering Committees (PSCs) were mentioned infrequently during the Review Team's KIIs, FGDs, and field visits, suggesting that the PSCs do not play a major role in AR program strategy and implementation. While some PSC members are very committed and engaged, constraints on the effectiveness of the PSC's oversight / guidance function appear to include: insufficient compensated time; low response rates by PSC members to email-based advice requests; a 'non-scientific' mandate (i.e. more commonly engaged in administrative matters).

Rationale: While it is valuable in concept to have a regional advisory group, in the context of significant budgetary and time constraints faced by regional AR projects, time and energy dedicated to the 'care and feeding' of PSCs should have a clear return on investment. A review of the PSC mandate and functioning could provide insight to inform fine-tuning and should place particular emphasis on:

- Robust review of the relevance of research sub-activities to program objectives (see Section 1.1-A);
- Balance across research domains in the funded portfolio (see Section 1.1-B);
- Shepherding a transition from new research toward research synthesis and impact assessment (see Section 4.4-D).

2. Data Management, Monitoring, Evaluation, and Learning

This section describes findings and identifies gaps, weaknesses, and solutions regarding how the AR program handles data management, monitoring, evaluation, and learning. IFPRI is responsible for data management, evaluation, and impact assessment for the AR program and the three regional projects.

Broadly speaking, the AR program generates data in two major inter-related streams: (i) Research activities produce quantitative data (e.g. from agronomic trials; geospatial data) and qualitative data (e.g. using structured / semi-structured questionnaires); (ii) Data to populate FtF indicators, submitted annually to USAID, which uses these data to produce progress reports, update the US Congress, and inform policy and program decisions.

Data management

2.1 Is the data management structure and organization efficient in Africa RISING? Is it ensuring that data from the field is used by project implementers as helpful insights for a better project management?

Context. In Phase II, all Africa RISING partners are meant to comply with the program's data management policy and to make use of data-sharing opportunities. All data should be fully accessible, following the terms and conditions laid out in the data management policy. Dataverse is the primary repository for data collected by AR and requires careful documentation of research protocols followed as well as clean datasets that are anonymized.

Recommendation 2.1-A: **Strengthen integration of research data with anecdotal information to enhance AR program insights for use by researchers, partners, and stakeholders**. (See Section 1.2-A, 1.2-B, 1.4-B, 2.1-B, 2.4-A, 3.1-C, 4.2-A, 5.1-A)

Observations. Quantitative and qualitative data are collected, managed, analyzed, and reported to meet the needs of different AR program audiences. Researchers use primary data to prepare peer-reviewed scientific publications. Development partners need data for assessing technology impacts on household income and nutrition. Policy makers can use AR-generated knowledge to inform public investments. Global donors and multilateral development agencies can benefit from evidence-based insights regarding the relevance of prevailing development theories and practices. These and other audiences may derive benefit from 'stories

from the field' that combine AR-generated quantitative data with anecdotal information related to technology benefits and challenges (see Section 2.4-A).[58]

Rationale. This recommendation encompasses quantitative and qualitative research data, M&E data, and anecdotal information shared by research and development partners and farmers who are directly or indirectly engaged in AR activities. Information can be gathered through research reporting templates,[59] M&E tools, partner and farmer interactions (see Appendix 6), and AR review and planning meetings. Insights can take the form of:

- Farmer stories that illuminate AR technology adoption (or context-specific adaptation).[60]
- Research partner stories that elucidate potential follow-on research opportunities (see Section 3.1-C).[61]
- Examples of multiple impacts of AR technologies.[62]
- Case studies of farmer-engaged research that demonstrate the potential for broader social benefit.[63]
- Factsheets or policy briefs that illustrate the broader implications of AR research for agricultural development and policy (see Section 2.4-A).

The M&E and Communications teams would play key roles in implementing this recommendation, eliciting anecdotal information and working with researchers to build communication tools.

Recommendation 2.1-B. **AR program leaders should monitor and evaluate how research and development partners use AR-generated data and information.**

Observations. AR regional projects strive to disseminate research findings[64] and it appears that various types of data and information are informing AR research project implementers, and other researchers, particularly through presentations at annual review and planning events (there have also been annual learning events where datasets and analyses are presented). However, the extent to which AR data and information resources are informing scaling activities with development partners is unclear.

Rationale. It would be valuable to gain a better understanding of how both research and development partners use different types of AR-generated data and information and which of these are found to be most useful to them. Program leaders should:

- Evaluate the extent to which different types of partners access AR data and information.
- Determine whether current data and information systems support development and dissemination of insights that are relevant to research and development partners and the development community more broadly.
- Consider ways that Technical Reports could be used to document data use for specific projects (see Section 1.1-C).

[58] Note that anecdotal information may support or contravene findings of more formal data-gathering exercises.
[59] AR researchers indicate that they have data for technology impacts on household income, labor, and nutrition, but lack dedicated time for analyses.
[60] For example, farmers, especially women in Ghana and Ethiopia, reported multiple (child) labor reduction, income generation, and ancillary household nutrition benefits associated with adoption of feed troughs. Farmers in Mali reported income and nutrition benefits associated with replacing some maize with sorghum in their cropping systems. A female model farmer in Ethiopia commented on a mindset shift (e.g. embracing crop diversification, resource use efficiency, and farming as a business) that she felt was the greatest benefit of her participation with AR training and technology testing programs. This suggests the value of evaluation work designed to understand, for different types of AR beneficiaries, the relative importance of exposure to specific technologies, training and support modalities, and other factors related to AR technology adoption and SI-related benefits.
[61] For example, in field visits at dual purpose sorghum trials in Mali, farmers shared their observations about sorghum digestibility and satiety relative to maize (their typical cereal crop), raising the possibility of follow-on research to investigate nutritional benefits of transitioning from maize to sorghum.
[62] For example, many AR research activities offer potential for multiple nitrogen-related benefits such as integrating nitrogen-fixing legumes that improve soil fertility (i.e. increased nitrogen availability; potentially increased carbon sequestration through enhanced soil organic matter) and supply more protein for human (grain) and animals (fodder) consumption.
[63] Ideally, case studies would be supported by statistical analysis to demonstrate that they are representative target beneficiaries (i.e. not outliers that would be difficult to replicate.)
[64] For example, the AR-ET project has compiled diagnostic reports and other research products on CDs for circulation to local partners.

2.2 Is the program's Data Management Plan, its level of implementation, and specific processes suitable to ensure proper collection, access, analysis, storage, and sharing of data as requested by the donor and CGIAR?

Context. The open access data management platform is meant to (i) provide implementation partners with a secure, web-based data storage and documentation repository; (ii) provide a set of procedures to capture, validate, and integrate indicators, which can generate periodic monitoring reports; (iii) provide a live repository for non-indicator variables used to provide baselines, context, and input variables to inform systems modelling and evaluations of interventions; and (iv) serve as a one-stop structured and searchable inventory of project and partner organizations, activities, and outputs catalogued in a consistent manner across the full AR portfolio, thereby enabling investment and institutional data to be linked to a range of data layers.

Africa RISING's Data Management Plan 2019–2021 and its specific processes are suitable to ensure proper collection, access, analysis, storage, and sharing of data.

- Section 1 discusses core issues associated with data generation, ownership, and confidentiality;
- Section 2 presents elements of data management, together with the different types (i.e. observational, experimental, simulated, geospatial, physical, project monitoring, FtF indicators) of program-generated data and their formatting;
- Section 3 discusses data security and acknowledgement;
- Section 4 illustrates the online data management and data entry application of the project mapping and monitoring tool (PMMT); and
- Section 5 sets the guidelines for sharing AR data within and outside the program.
- In consultation with USAID, the data management plan was discussed, agreed upon, and approved by the three CGIAR leading agencies (IITA, ILRI, and IFPRI).

Recommendation 2.2-A: **AR program leaders should guide and monitor more timely uploading of AR-generated data onto Dataverse.**

Observation. Since 2017, AR research data have been migrated to Dataverse, an open source research data repository software managed by Harvard University. Regarding data uploading onto Dataverse, the AR Program Data Management Plan (2019-2021) indicates that Chief Scientists and Principal Investigators are responsible for ensuring that data collection information is clearly identified in the workplans, confirming that data have been collected and uploaded annually (or on an appropriately regular basis), and working with research teams to identify the appropriate timelines for Open Access.

In KIIs and document reviews, the Review Team noted reluctance among AR researchers to upload data onto Dataverse in a timely manner. For the Interim Report, the Review Team compared what the West Africa regional project planned to upload on Dataverse (gleaned from the Africa RISING West Africa Project 2018/2019 Workplan) to what has actually been uploaded (gleaned from the Technical Report 2018 and Technical Report 2018-2019). As of October 2019, for Ghana, 1 of 4 datasets that were to be uploaded on Dataverse had actually been uploaded. For Mali, none of the 6 datasets that were to be uploaded on Dataverse had actually been uploaded. Since this interim assessment, the M&E team and AR-WA project leaders have reported greater data uploading.

Most download requests of AR baseline studies have originated from universities for the purpose of secondary analyses and comparative studies. This suggests there is robust interest in AR-generated data resources.[65] Of the total 'raw information' dataset downloads from Dataverse (N=74,739), approximately 98% relate to initial baseline data[66] and 27% are associated with 'rapid characterization' studies in Malawi and Tanzania. Note that some data downloads were data quality checks both internally at IFPRI and by AR data

[65] External researchers must request permission to access AR data files in Dataverse, which is generally given, except in cases where data collection is ongoing over a number of years (i.e. to ensure AR researchers have time to analyze and publish data before it is made public).

[66] 71% of these downloads were associated with baseline evaluation surveys in Ghana, Mali, Ethiopia, Malawi, and Tanzania.

managers, Chief Scientists, and Principal Investigators.[67] The ways that data are requested and shared with requestors as well as the number of data downloads has changed over time.[68]

Rationale. The processes for how data are gathered, transferred, entered, and made available for use is meant to be consistent with USAID Development Plan ADS Chapter 579, File Name: 579_073118) and the CGIAR Centers Open Access and Data Management Policy. All Africa RISING staff and collaborators must comply with the provisions and rules laid out in the Data Management Plan 2019–2021. AR-funded researchers should be encouraged to accelerate data cleaning and other steps necessary prior to uploading to Dataverse, with regular monitoring by AR project Leaders. This recommendation will be of particular importance to support the recommendation regarding meta-analyses (see Section 4.2-A).

Monitoring and Evaluation

2.3 Are programme and project M&E arrangements fit for purpose? What feasible modifications could strengthen them?

Context. M&E arrangements are meant to: (i) support effective project management; (ii) provide data for timely reporting to project funders (i.e. FtF indicators); and (iii) facilitate learning and reflection about successes and failures to inform adjustments to current and future implementation. In Phase II, monitoring responsibilities, including institutional key performance indicators, were devolved to regional teams (i.e. staffed by locally-recruited data managers / M&E specialists), while evaluation continues to be undertaken centrally by IFPRI.

Recommendation 2.3-A. **Program leaders should re-articulate and amplify commitments to monitoring and evaluation.** (See Section 1.4-C, 3.2-D, 4.3-A, 4.4-D, 4.6-B)

Observations. Based on document review and KIIs, it appears that most monitoring activities are geared towards supplying data for FtF indicators, which are required by USAID, with some effort directed to beneficiary tracking. This is relevant to one of the core M&E functions: timely reporting to project funders.

The Review Team encountered little systematic monitoring effort for other core M&E functions such as supporting effective project management and enhancing program-wide learning. It is unclear how monitoring data feeds back into project operations.[69] Importantly, the Review Team was unable to find tracking mechanisms for delivery against funded research sub-activities that meet basic expectations for easy access and consistency (see Section 1.1-A). Even though this should be a relatively simple undertaking, the Review Team found that a list of current sub-activities was available only on a request basis from project leaders and therefore developed its own tracking tables to assess research progress (see Appendix 4).

Rationale. Basic research activity tracking information (including anticipated and actual delivery dates) should be continuously up-to-date and readily available. Monitoring activities should serve all core M&E functions, including program management, not just donor-mandated indicator reporting. As the AR program approaches its final years of implementation, when the need for synthesis and learning becomes paramount, this is an appropriate time to amplify related commitments. Program leaders should clearly re-articulate the essential purposes of monitoring and evaluation (see Section 3.2-A, 4.3-A, 4.4-B, 4.6-B) and dedicate the necessary resources to ensuring these purposes are achieved.

Program leaders should consider investing in a dedicated M&E / learning specialist,[70] who would be charged with eliciting program-level insights in partnership with USAID counterparts (see Section 2.4-A). A key deliverable from establishing such a position would be an evidence-based version of the Footprint report (i.e. a narrative synthesis based on quantitative data) by the end of Phase II.

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[67] Personal communication: Arkadeep Bandyopadhyay, IFPRI, 3 March 2020.
[68] To improve on Dataverse's cumbersome handling of data requests, a Google Form is now used: https://docs.google.com/forms/d/e/1FAIpQLScX1L9cZGCKBJmpgRKrKI2hlvfKHo7Wj8BH446sn4ithlwiEA/viewform
[69] M&E leaders noted that data requests from AR researchers have been sporadic and primarily related to donor reporting and research publications with M&E team collaboration.
[70] For example, an IFPRI specialist could be seconded to one of the in-region lead CG centers.

Figure 2. Woman farmer accompanied by scaling partner in Lemu, Malawi.

Recommendation 2.3-B. **Program leaders should promote consistent use of strategies and tools for tracking all three types of AR beneficiaries, particularly scaling beneficiaries.**

Observations. For AR regional projects, there are: (i) direct beneficiaries, i.e. those directly engaged with AR research activities; (ii) indirect beneficiaries, e.g. those who attend field days; and (iii) beneficiaries of AR scaling activities, i.e. those engaged by development partners. Whereas data collection on direct beneficiaries is relatively straightforward, data on indirect beneficiaries is more difficult. Harder still is tracking scaling beneficiaries, which is complicated by the fact that AR activities are only a partial contribution to what most scaling partners deliver to their client groups. As noted in several KIIs, parsing out attribution to AR will, in most cases, be challenging.

A Beneficiary Technology Tracking Tool (BTTT) was developed to collect data on direct beneficiaries (i.e. those directly engaged with AR research activities) such as when they joined the program, innovations they have tested (disaggregated by year), and demographic characteristics. A separate 'exposure' template is used to collect data for indirect beneficiaries (e.g. those who attend field days).[71] The BTTT also provides project implementers with data on reaching targets for direct and indirect beneficiaries, but is not yet being implemented across all AR countries. Design of a tracking tool for scaling beneficiaries is still in the beginning stages.

Monitoring activities related to FtF indicators and beneficiary tracking differ significantly across AR countries:

- The WA M&E specialist has refined a number of monitoring tools, including: (i) an off-line tool for collecting FtF indicator data;[72] (ii) an updated beneficiary and technology tracking tool (BTTT); and (iii) a template for tracking scaling partner beneficiaries. With updated tracking tools now available, the Chief Scientist and project activity leaders can make use of them (e.g. to inform future AR activities).
- In Mali, the Review Team encountered divergence between program-level expectations and practice in-country with regard to collection and collation of monitoring data. A third-party firm was contracted to undertake a one-time data collection for AR project beneficiaries,[73] under the supervision of the WA M&E specialist, who subsequently incorporated the information into the Mali BTTT.

[71] Note that collecting detailed information (as in the BTTT) about these individuals is logistically difficult (compared to farmers with whom AR researchers and their local partners have regular interaction and from whom data can be collected over time.
[72] The offline tool mimics the online tool PMMT tool to support data entry in locations without good internet connection. It is being updated to reflect changes in levels of aggregation for FtF indicators.
[73] AR researchers / staff provided information on research and development partners that were then contacted by the firm.

- In Ethiopia, the four AR site coordinators and focal persons from extension offices are tasked with collecting basic data to populate FtF indicators.[74] Research partners indicated that collected data are not cross-checked by the AR project. Plans to harmonize FtF and BTTT data collection have not yet been realized.
- The BTTT has been only partially updated for Malawi and Tanzania due to staffing changes, which should be resolved shortly.

Rationale. Data collection for all three types of AR beneficiaries needs harmonization. For direct and indirect beneficiaries, this seems largely to be a matter of confirming that tracking tools are consistently used. Data collection for indirect AR beneficiaries should be improved. For example, AR-WA site coordinators should encourage re-establishing visitor ledgers at Tech Parks in Ghana and Mali and possibly a coordinated mechanism with community beneficiary farmers to track who they get in touch with or who seeks information from them.

For beneficiaries of AR scaling activities, completion of a program-wide tracking tool should be a priority given the central importance of scaling in Phase II. Active collaboration will be needed among AR researchers and staff (e.g. M&E specialists, Chief Scientists, site coordinators), as well as AR development partners, who will be essential contributors to data collection. Any effective tracking tool would need to be useful to development partners to incentivize them to invest the necessary time and effort to contribute. Each development partner is likely to have their own monitoring tools, so it will be critical to develop a scaling beneficiary tracking tool that enables harmonized data collection without expecting partners to undertake duplicative or uncompensated data collection.

Learning

2.4 Assess the extent to which the program has seized the opportunities for program-wide analyses and learning to foster synergistic effects across the regional projects?

Context. In Phase II, M&E arrangements are meant to: (i) help all stakeholders learn about successes and failures; (ii) facilitate learning and reflection that informs adjustments; and (iii) provide capacity to inform planning and long-term projections of potential innovation impact at scale, beyond the actual action research sites, and with the delivery of scalable innovations to partners.

USAID is interested to see the AR program generate less data while making good use of the data they have to leverage partnerships that bring AR-generated knowledge into use by the larger development community. In particular, USAID and country Missions would benefit from research-based insights about how to engage different farmer segments within agricultural communities based on livelihood categories (e.g. subsistence; integrated crop-livestock management; market-oriented) and intervention objectives (e.g. basic agronomy and animal science; labor-saving and efficiency strategies; farm diversification). Data-driven understanding of differentiated strategies for farmer livelihood categories could help to recalibrate project identification at USAID Missions and development agencies.[75]

Recommendation 2.4-A. **Build on existing learning activities within countries and regional projects to develop joint publications and program success stories, focused on program-wide analyses and high-potential outcomes and impacts.** (See Section 1.1-A, 1.2-A, 1.2-B, 4.1-A, 4.2-A)

Observations: Despite efforts toward program-wide analyses and recommendations (see Section 1.2), there has been minimal success (with no examples yet of meta-analyses[76]) so far despite strong interest and interactive engagement from USAID. The "Footprints of AR" compendium of Phase I AR activities was

[74] Site coordinators are supported by focal points in each woreda where AR operates (i.e. Extensionists who paid by AR for ~5 days / month over 5 months). It is unclear whether a uniform data collection template is being used by all four site coordinators.
[75] Missions and other entities commonly invest in agricultural technologies that are suitable only to better endowed farmers rather than basic agronomic interventions that are likely needed by many smallholders before they would be capable of investing in improved inputs or mechanization.
[76] Data aggregation and standardization are essential precursors to undertaking statistical analyses of large datasets.

referenced as an example of broader learning (although it does not address issues related to farmer engagement or broader impact).[77] The SIAF is seen by some AR researchers as potentially useful for supporting program-wide analyses (see Section 4.6-A).

While Africa RISING has ample programmatic flexibility (i.e. workplans are developed annually) and room to experiment with systems-level interventions, there are a number of constraints to program-wide analysis:

- Challenge of communicating interim insights from within a dynamic learning context.
- Regional AR projects struggle to generate syntheses across individual sub-activities (others noted newly emerging work in this area). Without such regional-level syntheses, it is difficult to generate evidence at the AR program-level for outcomes and impacts of AR-generated innovations. Lack of such syntheses also hinders cross-project learning and harmonization (see Section 1.2), and the ability to document generalized lessons (see Section 4.1) and plan future research.
- Persistence of disciplinary research orientations and tight budgetary contexts for CGIAR and other research partners as well as highly variable research frames across AR activities and protocols (other constraints have been discussed in sections 1.2 and 1.4).

Where cross-institutional research collaborations are strong, there is a basis for developing joint publications. For example, an ICRISAT-led effort will include examples from Ethiopia, Tanzania, Malawi, and Ghana in a synthesis on Mechanization of Smallholder Farming Operations. Handbooks on approaches to sustainable agricultural intensification for smallholder farmers are being developed in West Africa (led by Kizito, Hoeschle-Zeledon, and Odhong) and in East and Southern Africa (led by Bekunda, Hoeschle-Zeledon, and Odhong). A new cross-regional research effort focuses on translation from Tanzania to Ghana of Napier grass and pigeon pea as potential feed resources.[78] Preliminary analyses of market integration, agronomic practices, food insecurity, and poverty in northern Ghana, undertaken by IFPRI and USAID, will extended to Mali and possibly other AR countries.

Rationale: Across the regional projects, there are important differences in research approaches and outputs as well as applicability of resulting technologies. Consequently, for some elements of the AR research portfolio, it may be difficult to develop program-wide analyses that merit publication in peer-reviewed journals. Yet, there are a number of high-level commonalities across the regional projects that may lend themselves to joint analysis (and promotion) and thereby provide insights to global donors (i.e. for program design), policy makers (e.g. for agricultural support programs), and the private sector (e.g. widening seed distribution networks).

Increased efforts to produce program-wide analyses might, for example, focus on:

- Specific technology categories such as feeding troughs (WA, ET);[79] soil surface management (WA, ESA); poultry breeds, housing, and rations (ESA); crop genetics, field, and post-harvest management; vegetable genetics, production, income, and nutrition; and smallholder mechanization (all regions).
- Use of modelling to create research hypotheses and add value to data gathered through field trials.
- Systemic challenges (e.g. access to credit and improved seeds and other agricultural inputs).

It may be more efficient and effective to extend existing joint analyses and publications to include findings and approaches in other regional projects than it would be to start an *ex novo* effort. By building on work already underway within an AR country or regional project, there should be a conceptual foundation (e.g. defined questions about challenges and opportunities; initial country- or region-specific insights) that could be adapted to other AR countries or regions. A dedicated 'M&E / learning specialist' in the AR program could be instrumental in linking AR project-level data gathering to USAID information priorities such as program-level and single component impact (see discussion of M&E liaison in Section 2.3-A).

[77] In April 2020, the Communications Team will publish a program-wide synthesis report covering October 2018 to September 2019.
[78] Other examples include transfer of feed troughs, dual purpose sorghum varieties, and maize shellers across AR countries.
[79] Program-wide analyses could assess where, when, and how technologies have been adopted including using SIAF to assess primary and interactive tradeoffs / synergies (see Section 4.6).

Over the next two years, the Review Team recommends greater investment in telling the story of AR program successes (e.g. partnerships; participatory technology selection; scaling; novel methodologies), based on existing datasets (e.g. using SIAF to analyze technology tradeoffs, synergies, and impacts on income, nutrition, and food security) (see Appendix 7) and, where possible, emphasizing cross-regional insights. Promising areas for AR story-telling include lessons learned in partnership-based scaling (Section 4.7-A) and *ex post* socio-economic assessments of direct engagement farmers (Section 3.2-B) to better understand adaptation and adoption of AR-validated technologies. Development of AR success stories, factsheets, and case studies, targeted to donors, partners, educators, and scientific colleagues, can be initiated by researchers (i.e. promoting broader communication of their published work), regional project leaders, and communications specialists.[80] Semi-annual researcher reports could provide relevant content (Section 1.1-C).

Recommendation 2.4-B. **Assess the AR program's progress toward integration of agricultural and socio-economic domains in the context of similar programs.** (See Section 1.1-B, 1.2-B, 4.5-A)

Observations: Input supply chains, markets, household income and nutrition, and other socio-economic aspects have been weakly integrated into the AR agenda relative to agricultural productivity and environmental sustainability (see Section 1.1-B). This is poorly aligned with the over-arching AR program goal to build pathways out of hunger and poverty, for which multi-disciplinary and multi-institutional approaches are fundamental. The Review Team heard through KIIs that cross-learning has been strongly communicated by program leaders, however incentives may not be sufficiently tangible for knowledge exchange across different areas of expertise (e.g. agronomy, livestock, economics, gender, water resources) (see Section 1.2-B, 4.5-A).

Rationale: This is not the first instance where a large agricultural R4D program has aspired to a multi-objective approach. AR researchers and program leaders could review the AR experience relative to that of similar programs (e.g. the CG CRPs for Drylands, Humidtropics, Aquatic Agricultural Systems) to glean insights about program structures, researcher incentives, and other features that are conducive to multi-objective program implementation, monitoring, and evaluation.[81] This may be of interest to global donors and other entities interested in accelerating cross-disciplinary collaboration in agricultural research and development.[82]

3. Research and Development partnerships

This section describes findings regarding Research in Development partnerships of the AR program and identifies gaps, weaknesses, and solutions. Africa RISING is led by the CGIAR, which has historically utilized a 'technology supply' approach (e.g. validated varieties paired with agronomic recommendations), but is being pushed to take greater accountability for adoption and impact. Implementing partners are drawn from international and national agricultural research and extension systems, development organizations, farmers, community-based organizations, and agrodealers.

[80] As an example of how information in a peer-review scientific publication can be translated into factsheets and case studies, see the following links: https://acsess.onlinelibrary.wiley.com/doi/pdf/10.2134/jeq2013.09.0375; https://www.ars.usda.gov/ARSUserFiles/50901500/EducationalMaterialsMarch2012/ManureNutrientsandtheEnvironment/30%20MUN%202nd%20study_2015.pdf; and https://globalresearchalliance.org/wp-content/uploads/2017/05/USA-Dairy-N_LRG-case-study.pdf. Similarly, survey tools and methodologies developed as case studies (e.g. http://www.fao.org/fileadmin/user_upload/nr/sustainability_pathways/docs/India_Babcock_Institute_study.pdf) can be developed into factsheets https://www.ars.usda.gov/ARSUserFiles/50901500/pdf's/Nutrient_use_efficiency/Fact%20Sheet%20snap-shot%20assessment_2017.pdf.

[81] More targeted use of the SIAF (see Sections 4.4 and 4.6) may have relevance to this recommendation.

[82] For example, it might be suitable for a targeted study by the CGIAR's Standing Panel on Impact Assessment (SPIA) under the Independent Science and Partnership Council (ISPC).

Capacity to deliver research outputs

3.1 Review appropriateness of existing research partnerships to produce the expected research outputs for achieving the individual project's aims and program's purpose and contribution to the global knowledge base.

Context. In Phase I, four research outputs were formulated including:

- Situation Analysis and Program-wide Synthesis: best-bet or best-fit interventions are aligned to priority constraints and program-wide synthesis spans target areas;
- Integrated Systems Improvement: test, validate, and adapt specific interventions;
- Scaling and Delivery of Integrated Innovation: develop appropriate approaches for scaling out innovations;
- Integrated M&E Process: ensure that output-outcome linkages are clearly understood and that output findings feed into other outputs.

The AR Program Proposal for Phase II does not list specific research outputs, project aims, or program purpose. (Phase II logframes were developed for WA and ESA with specific program goals, purpose, outcomes, and outputs – see Section 4.3.)

Over the next two years, USAID would like to see the AR program go further toward synthesis, i.e. unlocking common elements from research outcomes to provide scaling partners with viable, common aspects to include in development work (resulting eventually in increased impact of investments).

Recommendation 3.1-A. **Maintain, strengthen, and backstop Research in Development partnerships**. (See Section 1.1-B, 2.4-A, 4.1-A, 4.7-B)

Observations. Africa RISING research partnerships are intended to increase capacity, agro-ecological potential, sustainable environmental and economic intensification of crop and livestock productivity, and engagement with wider R4D communities in developing and scaling SI interventions. Key types of research partnerships are established with CGIAR centers (e.g. leading or contributing to AR research activities), local and national research organizations (e.g. leading and managing research activities; supplying undergraduate or graduate student researchers; delivering extension services), and development organizations (e.g. implementing technical training; disseminating research outputs). Through AR document reviews, partner meetings, and field visits in Ghana, Mali, Ethiopia, Malawi, and Tanzania, the Review Team observed a high degree of research partner engagement (e.g. high levels of interactive participation by CG scientists; strong turnout for meetings; energetic participation in discussions; fluency in AR concepts and technologies; established relationships with farmers[83]) indicative of strong AR research partnerships.

Professors and graduate students at local and national universities are essential research partners for experiments at Tech Parks or in farmers' fields.[84] In addition to testing and validating agronomic potential,[85] this work provides critical data for assessing environmental impacts of some AR technologies (e.g. nitrate leaching; soil and nutrient runoff; greenhouse gas fluxes), for determining farmer aspirations, for delivering training, and for assessing input (e.g. labor) requirements and impacts of AR technologies. Several AR-engaged professors and other research partners noted that participation with the AR program was their first experience with multi-institutional and interdisciplinary research, which has helped them to frame the potential impacts of their disciplinary research within a larger, systems-focused effort.

Rationale. The Review Team proposes three general approaches:

[83] In field visits, the Review Team noted highly interactive discussions among AR researchers, farmers, professors, PhD- and MSc-level students, post-docs, and other national research partners.
[84] Farmer partners gain exposure to agronomic and environmental science as well as opportunities to compare AR-generated technologies to traditional crops, varieties, and practices.
[85] For example, student-led water balance research in Ghana through collaboration with KNUST may support local farmer claims that cowpea intercropping enhances soil moisture availability to maize during dry periods.

- Maintain valuable partnerships: While diverse in their structure and functioning, many of the AR research partnerships appear to contribute in important ways to AR program priorities, while also providing value to contributing research partners. The AR program provides unique opportunities for local researchers and technically trained professionals to gain experience with interdisciplinary research and to interact robustly with local farming communities. These interdisciplinary, multi-institutional, and multi-cultural experiences enhance scientific experience and capacity for all partners.
- Strengthen emphasis on Economic, Environment, Social, and Human domains: At the same time, AR research partnerships reflect the same bias toward the Productivity domain as observed across the AR program (see Section 1.1-B). To supplement AR socio-economic specialists (see Section 1.1-B), AR regional project leaders should pursue research partnerships that provide critical economic and social science capacity, especially related to household income and nutrition.
- Backstop research partners: Not all AR partnerships generate research publications to an adequate degree, suggesting that AR regional project leaders may need to amplify backstopping for research partnerships so that they are successful across the full arc of Research in Development projects (i.e. from farmer participatory research design and implementation to publication of results in appropriate scientific venues). (See Section 3.1-A, 4.7-B)

Figure 3. National research partners with farmer at a Tech Park in Madina, Mali.

Recommendation 3.1-B. **Evaluate outcomes of AR investments in training.**

Observations. AR research partnerships have prioritized training of graduate students[86] and development and delivery of technical training to site coordinators, field technicians, Extensionists, and other research project contributors, representing an important outcome area for Africa RISING.[87] The Review Team encountered several examples of AR-trained graduate students who had transitioned to R&D positions with AR partners (e.g. agricultural input services, research organizations, NGOs).

Rationale. The Review Team did not encounter mechanisms for tracking outcomes from training investments (e.g. who learned what; how technical knowledge was applied), nor for assessing how experience gained through delivery of trainings was used to enhance subsequent trainings. To understand the impact of AR-funded capacity building, AR project and program leaders should:

[86] For example, as of July 2019, Africa RISING provided research opportunities for many postgraduate students: 19 in Ghana (6 PhD, 13 MSc); 23 in Mali (8 Phd, 15 MSc); 37 in Ethiopia (12 PhD, 25 MSc); 18 in Malawi (6 PhD, 12 MSc); and 29 in Tanzania (5 PhD, 24 MSc).
[87] This observation is based on review of annual program plans, technology reports, budget allocations, field visits, and partner meetings. For example, at one research partners meeting, there was general agreement that training could be considered one of the most important outcomes of Africa RISING.

- Evaluate knowledge gain among trainees as well as opportunities in current roles to disseminate AR-related knowledge (e.g. how AR-trained students are contributing to agricultural R&D).[88]
- Assess further support needs of trainees (e.g. continued or next-level training opportunities for field technicians).
- Explore exit strategies such as self-sustaining train-the-trainer systems operated by NGOs, Extension, or other partners (see Section 4.7-B).

Figure 4. Students presenting their soil management and livestock research in Chehoyi, Ghana.

Recommendation 3.1-C. **Share the story of the AR integrated research partnership model.** (See Section 2.1-A, 2.4-A)

Observations. Africa RISING appears to function as a R&D 'integrator' that mobilizes and facilitates complex partnerships toward unified efforts. In partner meetings and field visits across all regional projects, participating organizations and farmers commonly referred to partnership activities as 'Africa RISING' rather than making distinctions about lead partners or specific research activities. The AR program appears successful in coalescing diverse objectives and capacities toward shared research activities and providing a larger context for specific technology development and validation efforts. Multiple partners commented that "if AR was not here, these opportunities would not exist" (see Section 4.4). Harmonizing technology-related information through partnership 'platforms' is valued for ensuring that appropriate messages reach farmers. At the same time, AR project leaders noted the need for realistic expectations about scaling partnerships.

Rationale. Africa RISING has a useful story to tell, that is relevant for the One CGIAR initiative, about undertaking research in a way that allows 'the whole to be greater than the sum of its parts.' In addition to USAID and CGIAR, other global donors, development agencies, research institutions, and organizations could benefit from understanding how Africa RISING facilitates the establishment and maintenance of these integrated research partnerships. To share the AR program experience with multi-institutional, farmer-engaged research, AR program and project leaders should develop concise, compelling descriptions that illustrate the participatory processes used to plan, implement, and evaluate technologies[89] and the diverse benefits accruing to partners. The Communications Team, in collaboration with the M&E Team, would play a

[88] This could be complemented by an alumni portal or other mechanism for linking and supporting current and former AR trainees.
[89] For example, in Ethiopia, at the start of Phase II, kebele-level meetings were convened to review all Phase I technologies with partners and lead farmers, who would select the best ones; at a subsequent district-level meeting, NGOs identified AR technologies they intended to disseminate among their beneficiaries. In Tanzania, an innovation platform is used to bring together diverse farmer, community, input supplier interests together to plan and evaluate on-farm research.

key role in developing themed publications,[90] case studies,[91] or stories[92] to be shared during meetings and field visits.

Recommendation 3.1-D. **Work through research partnerships to systematically characterize and address seed access challenges to scaling AR technologies.** (See Section 1.1-A, 5.2-A).

Observation. In many parts of Africa, reliable and affordable access to improved seeds is a widespread, systemic problem (see Section 5.2-A). Many validated AR technologies take the form of improved seeds, so poor seed access is a significant barrier to scaling. In discussions with farmers, low or no access to improved seed was very commonly mentioned as a major constraint to technology adoption for increasing cropland productivity.[93] Where access to improved seed had been achieved, farmers reported increases in income and nutrition (e.g. in Ethiopia, farmers indicated that they used increased income from improved wheat and barley to purchase more nutritious foods such as teff and vegetables).

While there are several examples within AR regional projects of seed multiplication efforts,[94] the AR program does not consistently apply a 'seed access lens' in protocol selection or systematically include seed access enhancement (i.e. value chain dimensions) in research activities. Seed multiplication projects encounter several challenges including: (i) dissatisfaction at low number of community members given the opportunity to participate;[95] (ii) sparse availability of official seed inspectors and their low familiarity with alternative crops inhibit transition from informal to formal seed systems; (iii) where markets for improved seed are underdeveloped, there is a risk that smallholder seed multipliers will sell for grain rather than as seed. AR efforts to work on seed delivery with agrodealers have had mixed results,[96] attributed in part to gaps in their knowledge and storage capacity, as well as weak or obsolete laws related to seeds.

Rationale. To build an environment that nurtures the biological resource of improved seed, there is an urgent need for AR research partnerships to more fully understand, account for, and attempt to ameliorate seed access 'bottlenecks' to scaling validated AR technologies.[97] Some approaches include:

- Systematically characterizing local to national seed access constraints and opportunities (drawing on best practices gained through broader CGIAR and NARS experience).
- Screening proposed research activities based on the feasibility of seed access (see Section 1.1-A).
- Supporting capacity building and experimentation in seed market development.
- Where relevant, expanding efforts to validate production practices for existing registered (i.e. 'on the shelf') varieties.[98]
- Forming strategic partnerships with proven private seed producers focused on learning and iterative co-development of solutions for seed access challenges.

[90] For example, focus topics such as mechanization (i.e. note the planned CIMMYT-led publication featuring maize and wheat planting and threshing technologies (Ethiopia), maize shelling technologies (Ghana, Tanzania), milling technologies (Tanzania), etc.
[91] For example, research in West Africa, led by IWMI and World Vegetable Center, on enhanced water use efficiency, household income, and nutrition in homegardens.
[92] Stories might focus on key technologies (e.g. feed troughs; mechanization; soil surface management; homegardens; nutrition training), emphasizing the roles of different partners in technology R&D and scaling.
[93] While other constraints were mentioned by farmers, none were so consistently and energetically raised as seed access.
[94] For example, in Laikala, Tanzania, AR is testing an informal seed system that relies on a 'pass along' process among participants and training individual community members as field inspectors for multiplication farms.
[95] For example, in Lemu, Malawi, community members questioned why they should pay for improved seeds when some in their village were provided seed (for multiplication) for free and were unconvinced when Extensionists explained that project participants "have to work for it" and that other farmers should purchase seeds at better rates through a village savings group.
[96] For example, in Malawi, attempts to harmonize with the private sector (e.g. soy and groundnut varietal testing; inoculant blend for doubled-up legumes) were not successful.
[97] Das B, Van Deventer F, Wessels A, et al. 2019. Role and Challenges of the Private Seed Sector in Developing and Disseminating Climate-Smart Crop Varieties in Eastern and Southern Africa. In Rosenstock TS, Nowak A, Girvetz E, Eds. 2019. The Climate-Smart Agriculture Papers: Investigating the Business of a Productive, Resilient and Low Emission Future. Cham, Switzerland: Springer.
[98] For example, in West Africa, AR researchers have undertaken validation and farmer selection activities for registered vegetable varieties, including Phase I studies with pre-existing registered varieties and with newly registered varieties that have characteristics preferred by farmers. Such studies are also undertaken with registered dual-purpose sorghum varieties.

Effectiveness of development partnerships

3.2 Assess the existing extent and effectiveness of development partnerships to achieve the beneficiary targets by end of the program's Phase II.

Context. Sustainable intensification innovations identified and tested within the AR action research sites are intended to enhance livelihoods through increased agricultural output, income diversification, reduced vulnerability to adverse environmental and economic challenges, and improved nutrition and welfare, especially of young children and mothers. Beyond providing benefits to smallholder farm households within AR action research sites, the program seeks wider adoption by facilitating partner-led dissemination of validated technologies. AR's demand-driven research seeks to ensure that the program's outputs are ultimately scaled to receptive and informed beneficiary households. The AR program seeks to engage 25,000 research households (based on farm typologies) and, through development partners, to scale AR innovations to 1M beneficiary households, catalyzing further partnerships and scaling to millions of rural people in USAID's Feed the Future zones of influence. As a research project, AR seeks to generate impact at scale through a 'partnership dividend' from co-investment with development partners (i.e. frontline public and NGO delivery systems; large development initiatives supported by USAID Missions; public-private partnerships).

USAID is eager to see the AR program package viable land rehabilitation and food security solutions for scaling by development partners. AR development partners include units of government, extension systems, national agricultural research institutions, development organizations, farmer groups, community-based organizations, and private sector (e.g. agrodealers). Partnerships are diverse, reflecting local and national contexts.[99] With the shift in emphasis toward scaling in Phase II, AR projects undertook a rolling, network-based scanning process to identify potential partners and evaluated their level of interest and capacity to contribute to scaling AR technologies.[100]

Partnership activities range from events (e.g. field days), capacity building (e.g. train-the-trainer), field demonstrations, and other knowledge-sharing mechanisms to establishment of innovation platforms, introduction of service provider models, and influencing government policy or guidelines (see Section 5.1-B). AR regional projects also provide practical support to development partners such as supplying inputs (e.g. seeds; fertilizers; mechanization) and financing learning and knowledge-sharing events. Through field visits and in-region meetings, the Review Team encountered ample positive feedback about AR projects from AR development partners (e.g. appreciating knowledge, technologies, coordination, and funding) as well as many suggestions for ways to enrich and expand partnership activities. Some development partners have successfully leveraged third-party investments in support of scaling activities and others have provided employment opportunities to AR staff whose positions were cut due to budget crises.[101]

Recommendation 3.2-A. **More explicitly define a learning agenda about scaling processes while continuing to scale AR technologies through high-functioning partnerships.**

Observations: Partner selection and the structures of specific AR partnerships will inevitably reflect the capacities of organizations operating in the AR target geographies. The Review Team did not encounter mechanisms for aligning development partnerships with an overall partnering methodology (e.g. participatory planning, priority setting, and implementation; mechanisms for mutual accountability and effectiveness) nor that there is a research agenda for partner-based scaling processes. In farmer field visits, the Review Team

[99] In the Ethiopian Highlands, government involvement is central to agricultural development down to the kebele level. In West Africa, local farmer outreach occurs through a combination of government and NGOs. In Mali, a weak Extension system means that local and international NGOs are critical providers of rural advisory services. Local NGOs tend to require greater capacity development.

[100] For example, in Ethiopia, organizations were invited to consultations based on lead researchers' perceptions about who would bring value as well as suggestions from others (e.g. USAID Mission). While many partners initially expressed interest, a number of these discussions did not progress (e.g. mismatched expectations about resources; inability to engage in due diligence processes), while others advanced to definition of roles and responsibilities.

[101] For example, budget crises stimulated reciprocal support to AR-Malawi by long-time partner, Total Land Care, and precipitated hiring of key AR staff by AMEDD in Mali.

encountered examples where a shared understanding of scaling activities was missing.[102] In field visits, it was not immediately obvious what scaling strategy and farmer engagement model had been selected and implemented.

In general, AR activities seem focused on producing information to support scaling rather than deliberately testing different scaling strategies.[103] In ESA, work has begun to summarize lessons on strategies for research and development partnerships in scaling agricultural technologies. Also, Africa RISING is pursuing opportunities to undertake impact studies through funding windows offered by the Standing Panel on Impact Assessment (SPIA)[104] and anticipates finalization of a framework to track the diffusion of agricultural innovations in developing countries commissioned by CGIAR-ISPC.[105]

Rationale: Without explicitly defined roles, scaling partnerships may be at risk of operational 'messiness' (e.g. AR incrementally pulled into subsidizing NGOs or commercial enterprises) or reputational risks (e.g. lending credibility to poorly conceived or implemented projects; perverse outcomes for sustainability or equity). Without systematically describing the scaling approaches considered and selected (and documenting the rationales and anticipated insights), scaling of research-derived knowledge and technologies may be prone to idiosyncratic or opportunistic implementation that provides minimal insight to future R4D programs. A learning agenda about scaling processes would:

- Bring equal attention and rigor to scaling activities as to research activities and would focus on understanding the factors that influence the productivity of a scaling partnership (e.g. multi-objective approach; investment in capacity building; shared priority-setting; clear roles and exit strategies – see Section 4.7-B).[106]
- Add explicit 'multi-directional' learning components to partnerships where these are absent (i.e. beyond a one-way transfer of validated technologies and knowledge to development partners).
- Define a structured process for assessing capacity of partners, for developing an engagement strategy with that specific partner, and tracking change in partner capacity (e.g. identify and test categories of approaches for transferring research outcomes to development partners).
- Share insights about co-investing with scaling partners (e.g. selection criteria; institutional arrangements; joint planning; formal vs informal partnerships).

This recommendation is distinct from research that informs scaling, such as systems-level work that provides evidence on which AR technologies are more likely to deliver net benefits under targeted agro-ecological and socio-economic conditions. Rather, research on scaling would evaluate which scaling partnerships and modalities are more successful in promoting technology adoption.[107]

Recommendation 3.2-B. **Define and assess how farmers are targeted for direct engagement in AR projects.** (See Section 2.3-A, 3.2-C-, 3.2-D)

Observations: While selection of direct engagement communities was guided by Phase I analyses (designed to ensure representativeness and alignment with FtF zones of influence),[108] processes for selection of participating farmers within communities seem to vary across AR sites with different degrees of reliance on

[102] For example, there was confusion among farmers regarding key features of the insurance / seed multiplication initiative in Kpatarrbogu, Ghana.
[103] For example, several local partners proposed that on-site monitoring and evaluation of AR interventions for impact on farmers and communities should be strengthened.
[104] https://cas.cgiar.org/spia/news/can-diffusion-strategies-adapted-characteristics-cgiar-innovations-enhance-and-sustain
[105] AR program leaders have also considered utilizing the IITA' Readiness to Scale procedure to test research outputs for scaling readiness, but would like to see this further mature.
[106] Focus could also be brought to viable technologies tested in Phase I that require further research on effective management practices (e.g. effective management of tree lucerne for livestock feed).
[107] For example, work on ICTs and partnering with government extension services in Ghana.
[108] Note that budget crises precipitated a reduction of direct engagement communities in Ghana from 25 communities to 18 (6 in each region distributed into 2 districts), which were selected because they had shown higher motivation and adoption. This has potential implications for representativeness.

local partners (e.g. Extension, NGOs, farmer organizations[109]) and farmer self-selection.[110] The Review Team has not seen systematic description of these farmer selection approaches.[111]

When AR target communities were initially selected, it is not clear if within-village resource heterogeneity (i.e. spectrum of well-endowed to less-well-endowed households) was addressed through household selection criteria. The Review Team did, however, frequently encounter farmer concern over the small number of farmers experiencing the benefits of direct AR engagement and heard numerous calls by farmers to expand the circle of participation.

During the Review Team's field visits, many featured farms seemed to be medium to highly endowed households (as described in Signorelli et al. 2016 and Kuivanen et al. 2016).[112] For example, in Mali, visited households owned bullocks to cultivate their fields and had long-term, stable access to fertilizers for cotton production (facilitated through a national program). These anecdotal observations suggest a need for careful documentation of direct engagement farmer selection and representativeness.

Figure 5. Direct engagement farmers in Tsibet, Ethiopia.

Rationale: If the AR technology validation has primarily engaged smallholder households with greater access to resources (e.g. land area; access to owned / rented machinery or traction animals; previous experience with testing agricultural technologies; market connectivity) and greater risk tolerance for agricultural innovation, this will affect the viability of scaling assumptions related to more poorly resourced farm households. Without an explicit description of the farmer engagement model, farmer targeting for direct engagement can appear to preferentially select farmers who have higher capacity (e.g. education; resources) and lower risk aversion than others in their communities.[113]

Descriptions will ideally include key production resources (e.g. land; labor; capital), household composition, and food security status (relative to broader regional and trans-African farmer populations). For example, in

[109] Some scaling partners (e.g. Total Land Care in Malawi) use a whole community approach which does not include farmer targeting.
[110] For example, farmer selection might be guided by a farmer's track record (e.g. open-mindedness and willingness to share knowledge with community members), farming capacity (e.g. capacity to follow-through without daily supervision), farm suitability (e.g. accessibility, appropriate size and type of available plot), and higher risk tolerance (land, previous experience).
[111] While no standardized methodologies for direct engagement farmer selection were observed, individual research activities do report basic information. For example, Mekonnen et al. (2019) describe farmer research groups who would participate in the study as "established based on farmers' common interests and technology choices." Baseline data on farmer characteristics were used *post hoc* in analyzing results (e.g. relationship of household resource status to tree survival).
[112] For example, farmers had relatively large cultivated land areas (including some that they rented out), sold grain and other commodities, and owned or rented traction animals.
[113] Divergent approaches among the three lead CG centers (i.e. random farmer selection vs direct engagement with higher capacity farmers) triggered PCT-level conflict resolution efforts (see section 1.4).

AR sites engaging farmers in mother-and-baby trials, it would be valuable to know which components of each technology were adopted, by which types of farmers (characterized by farm size, etc.), where / on what percentage of each adopting farm, and related impacts on food production and consumption.[114]

This recommendation does not suggest that a larger number of farmers could have been directly engaged (without additional funding and staffing capacity), nor that farmer selection processes were invalid. Rather, it highlights the importance of systematic description and comparative assessment of various AR farmer selection approaches for documenting that direct engagement farmers are representative (e.g. of their communities) and / or suitable to the selected farmer engagement model (e.g. lead / model farmer). It would also enhance capacity for robustly extrapolating farm-level outcomes (e.g. increased yield, diversity, and income) to estimate benefits of large-scale adoption.

Recommendation 3.2-C. **Reassess the mandate and use cases for farmer typologies.**

Observations: While not available to AR activity leaders and researchers until well into Phase II,[115] household-level farmer typologies (produced for a subset of AR action research sites) were intended to provide a framework for analyzing agricultural trajectories of farming communities, for targeting technology scaling strategies, and for undertaking impact assessments. In concept, farm typologies describe resource (i.e. land; labor; capital) heterogeneity in smallholder farming systems by stratifying farms into groups according to relevant criteria. However, the Review Team encountered little evidence that farmer typologies have been applied in AR research and development partnerships or that development partners are aware of typologies as a potential farmer selection resource. Several AR researchers indicated that it was not clear how the typologies could be integrated within their AR project framework and articulated the need for a simple (i.e. less 'academic') 'typology tool.'

As an *ex ante* tool for scaling to new communities (i.e. informing technology targeting; identifying 'entry point' individuals in communities), typologies may not have been well suited to the AR model of scaling technology packages through development partners, who have their own geographic focus, mandates, and established ways of engaging community members. To link farmers with suitable technologies (i.e. low 'activation energy' and adoption risk), AR researchers are developing technology extrapolation domains (i.e. spatial and temporal aspects of biophysical suitability) and an Impact Based Spatial Targeting Index that seeks to determine capacity to scale technologies to target populations by integrating demographic and value chain factors.

Some AR researchers indicated potential uses of the typologies (e.g. for national-scale targeting; to evaluate synergies and tradeoffs when applying the SIAF; for co-identification of barriers to adoption; for *ex post* assessment). IFPRI is exploring integration of the typologies into the FarmMATCH simulation model to guide beneficiary targeting at village and larger scales. More recently, collaboration with USAID has produced a pyramid-based conceptual framework for progression of low-endowment farmers toward commercialization (see discussion of livelihood categories in Section 2.4). Some AR protocols include modelling to extrapolate field trials to broader areas (e.g. potential scaling zones for sorghum varieties in Mali).

Rationale: The AR program has developed information about farm household types, but these are not yet linked to estimating benefits, adoption potential, or scaling strategies for AR technologies. Given current uncertainty regarding integration of typologies, assessment of their potential applications (e.g. *ex ante* benefit estimation; beneficiary targeting) could help AR program leaders and researchers to more strategically promote and support their use.[116]

Recommendation 3.2-D. **Candidly re-assess beneficiary target-setting process and share insights.**

[114] Through mother-and-baby trials in Malawi, 4000 farmers in Linthipe have reportedly adopted AR technology components (e.g. soil fertility management; improved germplasm; crop combinations) and some 800 households in Lemu have reportedly adopted components of conservation agriculture (e.g. residue management; reduced tillage; use of herbicides and fertilizers).
[115] Wageningen began producing typology reports in 2017. Training for application of the typologies within the AR projects was offered in 2019.
[116] M&E leaders indicated that this has been initiated.

Observation: AR R&D partnerships are meant to provide direct and indirect beneficiaries with opportunities "to move out of hunger and poverty through sustainably intensified farming systems that improve food, nutrition, and income security, particularly for women and children, and conserve or enhance the natural resource base." In development of the Phase II proposal, beneficiary targets were based on estimated annual increases in direct beneficiaries and estimates of other beneficiaries that could be reached through established and potential scaling partnerships.[117]

Several AR research leaders commented that beneficiary targets were overly ambitious and were based on over-confidence about capacity among anticipated scaling partners. For example, in Ethiopia, the large number and geographic reach of Extension agents supported optimistic target-setting, while in practice Extension partners needed significant support by AR researchers and staff. While some 'vertical' scaling activities are yet to reach a point where the actual impact can be known (e.g. combined insurance and seed multiplication scaling activity in Ghana; fertilizer policy shifts in Ethiopia), many of the 'horizontal' scaling activities appear ready for at least an initial reality check of representativeness and adoption potential. Funding from USAID Missions appears to be a significant factor in progress toward beneficiary targets.

Rationale: Reassessment of the process used to identify and estimate target populations and scaling potential, (including underlying assumptions about representativeness, scaling capacity, and development partners) would enable AR program and project managers to 'ground truth' the target-setting process. A publication that presents insights about scaling estimation (e.g. implications of scaling strategy and partner selection) could be of broad interest among global donors and development agencies. Such a publication could also offer a perspective on the importance and viability of ambitious beneficiary targets (in the context of an R4D program) relative to understanding mechanisms for system-level impacts. Also, where possible, presentation of AR impact estimates could reference beneficiary estimates in the Phase II proposals.

Links to USAID initiatives

3.3 How could new USAID initiatives such as the USAID Policy and Private Sector Engagement (PSE) be integrated in the program?

Context. Given USAID's overall interest to understand effective investments in sustainable intensification, there may be synergistic opportunities for linking components of the AR program with existing and emerging USAID initiatives.

Recommendation 3.3-A. **Explore linkages between USAID's Policy and Private Sector Engagement and scaling strategies for AR technologies.**

Observations. The USAID Private Sector Engagement Policy, focused on the "micro, small, medium, and large enterprises that operate in the formal and informal sectors," seeks to reach the poorest and most vulnerable populations. The PSE examines the role and comparative advantages of different local private sector actors in filling critical gaps, sparking innovation, offering expertise, providing vital infrastructure and supply-chains, shaping investment, and building the resilience of communities.

Several types of AR-validated technologies may lend themselves to scaling through private sector pathways including:

- Animal housing and feed troughs offer potential to increase feed use efficiency, decrease feed wastage and costs,[118] and reduce labor.[119] In all three regions, the Review Team noted high demand for these

[117] Estimates were developed slightly differently by country.
[118] For example, one Ethiopian woman reported using net profits from feed trough use to invest in a water pump for irrigating cash crops, installation of a metal roof on her feed trough, and purchase of additional forage for her dairy cows.
[119] Some farmers reported that feed troughs reduce child labor in herding and watching animals, allowing children are able to spend more time in school (although the Review Team commonly noted children engaged in farm work during weekdays).

technologies[120] as well as individual design innovations.[121] Through AR projects, local artisans (including youth) have been trained to build animal housing and feed troughs, offering them income potential.

- Small-scale mechanization technologies such as maize shellers, feed mills, and forage choppers can provide very significant labor savings. In Ghana and Tanzania, Africa RISING has fostered cooperative ownership and maintenance models. There may be opportunities for individual entrepreneurs to develop viable service delivery models and for local fabricators to adapt designs to fit specific needs.
- Access to improved seeds is a high priority among AR-engaged farmers. In Tanzania, the AR partnership with Meru Agro-Tours has increased distribution of drought-tolerant and N-efficient maize varieties developed and validated by CIMMYT.

Rationale. With notable exceptions, most AR scaling partnerships are with NGOs, development projects, or government. Given the AR focus on income as essential to food security, greater emphasis is warranted on private sector partnerships that open up potential income opportunities in input and output value chains (e.g. simultaneous technology validation and market development; testing of farmer aggregation models linked to training for local agrodealers).[122]

Where market-based approaches and private sector capacity and expertise offer promise, AR project leaders should explore opportunities for USAID's PSE[123] to support private sector engagement in scaling of AR-validated animal housing / feed troughs and small-scale mechanization technologies (i.e. pilot tests of design, fabrication, and service provision). To explore feasibility, AR leaders could identify and consult with local private sector actors to jointly analyze opportunities, constraints, and tradeoffs.

Recommendation 3.3-B. **Africa RISING should continue to cultivate its interactions with other USAID-supported research initiatives.**

Observations. The AR Scientific Advisory Group (SAG) was established in Phase I as an independent body charged with ensuring continuous, high-quality science in the AR program and compliance with its evolving research framework. The SAG met in person and virtually in 2014 and 2015 and was suspended (due to budget uncertainties) early in Phase II. Discontinuation of the SAG suggests that its mandate,[124] and scientific interactions generally, should be achieved through other mechanisms. One important mechanism would be to continue to strengthen on-going interactions with USAID-funded Research in Development programs. The AR program already interacts with the USAID's Feed the Future Sustainable Intensification Innovation Lab (e.g. development of the SIAF; joint field trips; participation in SIIL meetings).

Rationale. Where feasible and useful, AR research leaders should continue to deepen interactions and / or partnerships with Feed the Future Sustainable Intensification Innovation Labs and investigate possible collaborations with The Famine Early Warning Systems Network (FEWS NET)[125]

[120] For example, during a farmer meeting in Northern Ghana, about 80% of a large farmer group expressed interest in adopting feed troughs at their own expense; women noted that feed troughs are instrumental in saving labor and expanding small ruminant production. The Review Team also heard anecdotal reports of 80 feed troughs adopted and another 200 planned in Ethiopia.
[121] For example, some farmers have added a room behind their feed troughs for housing small ruminants overnight and for seed storage.
[122] AGRA. (2019). Africa Agriculture Status Report: The Hidden Middle: A Quiet Revolution in the Private Sector Driving Agricultural Transformation (Issue 7). Nairobi, Kenya: Alliance for a Green Revolution in Africa (AGRA).
[123] Via USAID's Mission / Office of Acquisition and Assistance, and Office of the General Council, Regional Legal Officer (GC/RLO).
[124] Advice in areas such as scientific direction and implementation; priority setting; strategic program elements (e.g. gender mainstreaming, innovation, capacity development) and partnerships; external linkages; and opportunities for better performance and increased relevance.
[125] Created by USAID in 1985, FEWS Net helps decision-makers plan for food shortages and humanitarian crises by annually projecting the prevalence of food deficits in 28 countries (including Ethiopia, Mali and Tanzania) based on meteorology, crop yield estimates, and other food security factors. There might be opportunities for methodological comparisons between AR's ARBES and FEWS NETS models.

4. Research achievements

This section describes findings regarding research achievements of the AR program and identifies gaps, weaknesses, and solutions. Africa RISING has five program-wide hypotheses (established in Phase I and carried forward to Phase II):

- Integration hypothesis: Integrating technological components into SI systems confers more benefits to smallholder farmers than single components. Innovations with components that mutually reinforce whole farm performance / productivity produce greater and more sustained benefits than the adoption of single-purpose technologies and practices.
- Adoption hypothesis: Integrating technological components into SI systems stimulates more adoption compared to single components.
- Tradeoff hypothesis: Targeting better tailored interventions that suit the context-specific environments and the diverse local conditions of smallholder farms / households will lower environmental damage. Effective targeting of innovations reduces the negative impacts of tradeoffs between farm productivity and environmental sustainability and helps to identify potential 'win-win' options for SI.
- Innovation sequencing and sustainable intensification pathways hypothesis: The adoption of innovations that lead to SI is affected by the sequence in which the component technologies, practices, and knowledge are integrated and applied, whereby any step resulting in reduced farm-level outcomes will reduce the ultimate uptake of these innovations.
- Scalability hypothesis: Agricultural SI interventions that are tailored to diverse local conditions on smallholder farms are more likely to be scalable to similar populations and environmental settings. A research approach based on targeting and evaluating SI-related innovations increases the relevance of findings from action research sites and enhances their scalability to similar strata elsewhere (i.e. to similar development domains and household typologies in other locations).

It is important to note that the current structure and priorities of the AR program reflects the mandate and conditions during its initiation in Phase I. Sustainable intensification was weakly defined at the time that the AR program was initiated (even now, a Handbook of Agricultural SI Approaches is still in process). Initial AR activities sought to deliver unique technology options integrated across crops, livestock, and natural resource management, using an evolutionary, 'learn as we go' approach.

Early in Phase I, researchers largely specialized in production dimensions. While socio-economic specialists have been integrated into the AR program, they have had to find entry points to collaboration within a pre-existing programmatic structure. Expertise in systems research is also relatively new to the AR program[126] and, within scaling partnerships, this approach faces barriers such as: (i) focus of government partners on political considerations, which may entrench distorting subsidies and other SI-incompatible policies; (ii) focus of private sector partners on specific commodities, technologies, or types of farmers;[127] and (iii) variable levels of interest in SI technologies across households.

Despite an expanded mandate and chronic budget uncertainty in Phase II, progress has been made toward the five program-wide outcomes. Across all sites, AR boasts a diverse portfolio of cropping systems, vegetable production, livestock, and soil management technologies. Multiple sites are testing technologies that enhance animal genetics, housing, feeding, and production; poultry and manure management; mechanization of smallholder farms (e.g. maize shelling; forage choppers; feed mills); and household nutrition. Farmer participatory research models demonstrate high engagement and interest in technologies (see Section 4.4-A).

[126] Increased exposure to and expertise in systems research methodologies and tools among AR-affiliated CGIAR researchers could be a valuable programmatic outcome.

[127] Offtakers and small-scale traders often focus on specific commodities (poorly aligned with diversified SI); finance providers seek to cherry-pick lowest risk opportunities with short term ROI (poorly aligned with AR emphasis on food insufficient people); agri-entrepreneurs want to promote specific technologies (that will not be suitable everywhere and may not deliver farm-scale ROI).

Recommendations in this Section relate to near-term needs to summarize research including greater use of meta-analyses to estimate technology impacts on household food security, income, and nutrition.

Progress toward research questions and meta-analysis

4.1 Assess to what extent the program and the three regional projects have made progress towards answering the research questions laid down in the Program proposal.

Context. The AR program seeks to identify and evaluate demand-driven options for sustainable intensification that contribute to rural poverty alleviation, improved nutrition, equity, and ecosystem stability. In Phase II, research focus was meant to shift to backstopping scaling activities, research on systems evolution / intensification, and application of typologies (i.e. analysis; targeting). Intended program-level research outcomes include:

- Integrated innovations increase production and / or improve productivity in a sustainable manner for the most relevant farm typologies within the AR action research sites.
- The aggregated impact of these farming practices at the farm / household level contributes to an improved understanding of ecosystem stability at the landscape level.
- Wider dissemination of integrated SI innovations leads to similar impacts beyond the AR research sites.

Recommendation 4.1-A. **AR regional project leaders should summarize evidence related to program-level research questions and use to establish upcoming research priorities.** (See Section 1.1-A, 1.1-B, 1.2-A, 2.4-A, 3.1-D, 3.2-A, 4.4-B, 4.5-B)

Observations. The Phase II AR Program proposal articulates the following research questions (see pp 20, 26):

RQ1. Tradeoffs and synergies: *What are the environmental, economic, human and social consequences (according to the SI framework) of productivity-enhancing interventions? And what are the productivity-enhancing consequences (according to the SI framework of environmental-, economic-, human- and social-enhancing interventions)?* The Review Team found that very few AR project sub-activities explicitly apply tradeoff analyses (see Section 1.1-A), although a number of AR technologies and research outputs could generate evidence related to assessing impacts on different SI domains (see Section 4.6). Examples of possible tradeoffs and synergies are presented in Appendix 7.

RQ2. Adaptation / adoptability: *How are these interventions aiming at increasing productivity and environmental conditions adapted to the endowments of diverse farmer typologies in the target areas and how do enabling conditions (e.g. access to markets, agro-inputs, finance) affect this adaptation process?* As discussed in Section 3.2-C, farm household typologies have not been well integrated into AR research activities. Most AR research sub-activities generate evidence related to productivity and a smaller number generate directly relevant evidence on economic and environmental conditions (with some potential for insights from modelling activities). There is limited research on the institutional environment and the role of institutions in fostering adoption, though basic evidence is possible from current and future research into factors affecting adoption of AR-validated technologies (see Sections 1.1-A, 2.4-A, 3.1-D, and 5.2-A).

RQ3. Livelihoods: *How do changes in the management of specific activities or combination of activities within a farm (e.g. a field or a livestock unit) affect overall livelihood conditions for different farmer typologies?* Given weak integration of farmer typologies into AR activities (see Section 3.2-C), this will be difficult for AR researchers to answer. Research focused on nutrition and gender can contribute to answering this question, though not necessarily by farmer typology. For example, vegetable adoption studies could contribute to more diversified, micronutrient-enriched diets, improving health and nutrition outcomes. The gender study underway in Ghana, Ethiopia, and Tanzania can help research and scaling partners to ensure that women farmers are being reached, that their preferences are being taken into account, and they are supported toward greater autonomy in decision making and higher net incomes (see Section 4.5-A).

RQ4. Enabling: *How do enabling conditions affect the nature (variety, agro-inputs, complexity, diversity) of promising interventions moving towards SI?* The current low emphasis on institutional, policy, and value chain contexts will make this question difficult to answer.

RQ5. Equity: *How does social capital affect community productivity, cooperation and wellbeing along with the scaling of SI innovations?* The structure of this question does not indicate that equity has been a carefully defined arena for AR research. For example, a more carefully constructed question might be: "How do social capital, collective action, and cooperation affect adoption rates of AR-validated technologies, particularly among often disenfranchised segments of the population such as women, young adults, and ethnic minorities (i.e. local effects), and what is the role of social capital, collective action, and cooperation in scaling SI technologies (i.e. extra-local effects)?" Equity considerations (i.e. social capital, collective action, and cooperation) are of central importance to the scaling potential of AR-generated technologies because of their implications for adoption by various population segments at the local level and for the role of institutions in helping to scale SI adoption. However, the Review Team found little evidence that this research question has received meaningful attention by Africa RISING and, therefore, this question will be difficult to answer. As discussed in Section 3.2-B, the AR program is encouraged to systematically describe AR farmer selection approaches, which would illuminate the relative social capital of direct engagement farmers.

RQ6. Scaling Research: *Phase II offers the team an opportunity to work with others in a community of practice across the CGIAR Research Programs (CRPs)— as the Maize and Livestock Agri-Food systems CRPs—and with other partners to develop and validate scaling models that will facilitate the uptake of SI interventions.* As discussed in Section 3.2-A, there has been limited AR research that assesses the strengths and weaknesses in different scaling approaches.

Rationale. By taking stock of AR-generated evidence relevant to answering program-level research questions, AR leaders will be able to identify major evidence gaps and set research priorities to fill these gaps. While sub-activity proposals for 2019 / 2020 may have already been selected, the PCT could work closely with AR regional project leaders to identify near-term opportunities (see Section 1.1-A) to prioritize in annual proposal selection. For example, a number of key informants have suggested that each regional project has the ability to summarize relevant evidence from sub-activities into well-structured evidence for project outcomes[128] (and to communicate findings as case studies, in fact sheets, etc.) Consistent with Section 1.1-A, future calls for protocol submissions should actively prioritize work on topics that are necessary to achieve project and program outcomes and to answer program questions.

4.2 Assess to what extent the current implementation of the three projects allows for meta-analysis of obtained research data.

Context. As part of Phase II's focus on cross-regional harmonization, AR regional projects are intended to share research data and contribute to meta-analyses related to the five SI domains. Africa RISING has a few examples of program-wide technology testing. Country-level research results have been analyzed for: (i) feed troughs adapted for dairy and small ruminants initiated in Ethiopia and expanded to small ruminants in Ghana, Mali, and somewhat in Malawi (associated with goat breeding research); (ii) smallholder mechanization (e.g. maize shelling research started in Tanzania and extended to Ghana); and (iii) homegardens and nutrition across all regions. It is uncertain if all data have been collated for cross-regional analyses and comparisons. Drawing cross-regional conclusions for such analyses would be problematic given the likely variation in treatment structures and trial management.

The central purpose of meta-analysis is to investigate the impacts of AR-validated technologies on household food security, income, and nutrition. Although AR projects operate in agricultural systems dominated by cereal production (e.g. maize, sorghum), the program's mandate is focused on system-level impacts of technologies across five dimensions. Therefore, meta-analyses should be scoped beyond productivity of cereal crops.

[128] Examples include feed troughs for small ruminants, smallholder mechanization, soil surface management (e.g. contour bunds, fanya juu, tied ridges) household gardens, and nutrition.

Recommendation 4.2-A. **Use meta-analyses of long-term Africa RISING data (and other data sources) to estimate technology impacts on household food security, income, and nutrition.** (See Section 1.1-B, 2.2-A, 2.1-A, 2.4-A, 3.1-C, 4.1-A]

Observations. In both Phase I and II, Africa RISING has accumulated substantial information on agricultural production and social parameters for a wide range of households. Among AR researchers, there is suitable scientific expertise[129] for meta-analyses of long-term Africa RISING data (and other data sources) to provide, at minimum, crude estimates of some technology impacts on household food security, income, and nutrition.

Rationale. Recognizing that substantial crop production losses occur during harvest, transport, and storage,[130] that some crops may be used as fodder, and that markets and other factors affect actual consumption and nutrition, AR should prioritize articulating the potential food security, income, and nutrition impacts of validated technologies. Simple, straightforward relations seem warranted between household production (i.e. cereals; legumes; vegetables; livestock) and household food needs. For example, on a household basis, cultivated areas (in hectares) devoted to specific crops, crop mixtures, and vegetables, and associated estimates of yield (actual or regional data) could be used to approximate, at minimum, total calories produced by a farm on an annual basis. Household composition (converted to adult equivalents) could be used to estimate household energy (caloric) requirements. Caloric requirement divided by caloric production would provide an indicative estimate of a household's potential food security. Estimated relationships could be refined when combined with information on household daily meal number, meal composition, and nutrition. Such data is reportedly being collected by AR partner, RECODA, in Tanzania.

AR researchers have suggested that activities undertaken through the AR-NAFAKA partnership[131] may lend themselves to meta-analysis, focused on understanding impact of validated technologies, given robust data gathering on household characteristics and cropping patterns and participants in mother-and-baby trials. From a NAFAKA test case, methodologies could be developed for meta-analysis related to other AR partnerships and sites.[132]

4.3 Assess progress made towards the planned outcomes as laid out in the projects' logframes, where applicable.

Context. Logframes are typically used to: (i) depict clear linkages between program-level activities, outputs, outcomes, and impacts; (ii) monitor and evaluate program performance; and when needed (iii) logically re-allocate resources towards activities that are most likely to achieve desired program impacts and goals.

Recommendation 4.3-A. **Simplify program logframes (theory of change) to focus on indicators that clearly establish linkages among program activities, outputs, outcomes, and impacts.** (See Section 2.3-A)

Observations. In Phase II, logframes were developed for West Africa and East and Southern Africa. These regional project logframes focus on four outcomes related to improvements in market-linked production, use of nutrition-enhancing technologies and practices, increased access to production assets and markets, and

[129] For example, see Manda J, Gardebroek C, Makaiko G, et al. 2016. Determinants of child nutritional status in the eastern province of Zambia: the role of improved maize varieties. Food Security, 8:239–253; and Manda J, Gardebroek C, Kuntashuls E, Alene DA. 2018. Impact of improved maize varieties on food security in Eastern Zambia: A doubly robust analysis. Review of Development Economics, 22(1):1–20.

[130] Post-harvest grain losses can range from 25-40%. Managing post-harvest losses can itself lead to the desired outcomes of increased food security and nutrition. Drying in collapsible envelopes, mechanised shelling, and hermitic storage can reduce grain losses by up to 84%, suggesting that post-harvest management may be a better technology choice than production-increasing technologies if all the SI domains are considered.

[131] NAFAKA takes a multi-dimensional approach to food and nutrition security for smallholder farm households, focusing on agricultural productivity, income, markets, and trade in maize and rice systems (see https://www.usaid.gov/documents/1860/feed-future-tanzania-nafaka). Africa RISING's partnership with NEFAKA is anchored in lead farmer training, demonstration plots, and access to inputs (e.g., improved seed, fertilizer, lime, pesticides) and emphasizes collaborating with farmers to identify research questions and methods (i.e. via an innovation platform). A key AR contribution to the multi-partner NEFAKA effort is scientific expertise and technical support (e.g. testing and publication of training manuals).

[132] Such meta-analyses could also be developed into a case study that illustrates impacts of AR technologies on household income and nutrition (see Section 2.4).

technology uptake through partnerships. The ESA project has a fifth outcome related to natural resource integrity and resilience to climate change. While progress towards achievement of program outcomes is evident in these regions, it is not obvious how project logframes are specifically used to monitor and evaluate progress and plan future activities.

AR Ethiopia did not develop a Phase II logframe *per se*,[133] rather it employed a Theory of Change,[134] to systematically assess what would need to happen in order for desired outcomes to occur. It is designed to explain how and why change happens, as well as the potential contributions of partner organizations. Top-level outcomes defined in the Phase II proposal have been used together with the individual research activities described in research protocols (these are the basis for issuing sub-contracts), which include sections on impact pathways and target beneficiaries.

Rationale. To gain the benefits of a logframe for strategic M&E and programmatic course correction, tight connections among activities, outputs, outcomes, and impacts should be logically constructed and anchored in carefully selected indicators. This has not yet been achieved in the three regional projects. For example, the WA logframe has a plethora of indicators, many of which seem too broad for the purposes of monitoring and evaluating program outcomes and impacts and may be difficult to populate with data. The ESA logframe seems to have more targeted indicators derived from follow-up project surveys, AR-derived research data, and research products. Flexible selection of indicators (i.e. to reflect the focus of specific research activities) is valuable. However, if an objectively verifiable indicator cannot be easily and straightforwardly connected to outcomes and impacts, then it does not support the central purpose of a logframe. As proposed in Section 2.3-A, investment in a dedicated M&E donor liaison could support improvement in AR regional project logframes or analogous tools.

Suitable, equitable benefits

4.4 Are the key research activities and outputs suitable to provide effective and sustainable pathways out of hunger and poverty for the program's target groups?

Context. USAID is eager to see AR-developed innovations help farm families graduate past livelihood thresholds (e.g., eliminate hungry seasons; improve household nutrition; increase focus on cash income; increase resilience). The AR program's equity objectives focus on how social capital affects community productivity, cooperation, and well-being, along with the scaling of SI innovations.[135]

Recommendation 4.4-A. **Continue to enrich mechanisms for direct farmer engagement in prioritizing challenges and selecting preferred technologies.** (See Section 4.5-B, 4.7-C)

Observations: Direct AR engagement with farmers hinges on their voluntary participation and selection (at an individual or small group level) of preferred technologies. Africa RISING's engagement standards for participatory research specify:[136]

- Avoiding extractive diagnostic studies that raise farmers' expectations of future exchanges without delivering direct benefit to farmers.
- Active community engagement in setting objectives, selection and prioritization of topics, and mutual agreement on approaches and interventions at the start of the research process.
- Role-sharing (e.g. in data collection, monitoring and evaluation).
- Access by non-participating farmers to technology transfer (e.g. through field demonstrations or participatory variety selection).

[133] Project leaders noted that they attempted to develop a logframe, but found this was a poor fit with their approach.
[134] https://usaidlearninglab.org/lab-notes/what-thing-called-theory-change and https://www.theoryofchange.org/library/toc-examples/
[135] Of course, within and across the different AR regions, farmers operate in very different production contexts (e.g. land competition, labor and machinery availability, population densities, value chain maturity) that significantly influence the approach to sustainable agricultural intensification.
[136] Africa RISING. 2015. Engagement standards in participatory research for the Africa RISING Program. Nairobi, Kenya: International Livestock Research Institute.

- Accounting for cultural norms and including gender as a significant component.

Many of the direct engagement farmers met through field visits displayed keen awareness of AR project objectives (while occasionally sharing alternative priorities), clear understanding of AR technologies, and appreciation for training and support gained through Africa RISING (as well as frequent requests to expand engagement to other farmers in and beyond their communities). Most farmers participated enthusiastically in field discussions, volunteering their perspectives about the benefits and limitations of AR technologies and training experiences.[137] Farmers provided very positive testimonials about training experiences (see 3.1-B).[138]

The Review Team encountered many examples of technologies perceived by farmers as delivering meaningful farm-level (e.g. crop yield; livestock productivity; soil quality) and household benefits (i.e. labor savings; nutrition; income), with variation in preferred technologies across individual farmers and across target communities. In action research sites where nutrition activities were implemented (e.g. vegetable production; food preparation), farmers described meaningful improvements in household food consumption patterns and nutritional outcomes. It seems that, as solutions were tested and validated, non-participating farmers began to advocate for access to validated technologies (e.g. access to improved seeds – see section 5.2; technical support for poultry and small ruminant housing and feeding structures; soil surface management) and direct engagement farmers quickly developed an appetite for solutions to additional farming challenges.

The AR Baseline Evaluation Survey (ARBES), community needs assessments, and other diagnostic work in Phase I heavily informed identification of the technologies tested in both Phase I and II. These technologies fall into thematic areas (e.g. improved crop varieties / management; high value crops including vegetables; soil / water conservation; reductions in post-harvest losses; food processing and preparation; poultry and livestock genetics, housing, and feed / ration formulations) that are considered to be 'pre-screened' for relevance to hunger and poverty reduction.

Rationale: While documented farmer needs have heavily influenced identification of technologies to be tested within AR projects, these needs can evolve over time (e.g. as climatic,[139] supply chain, and policy conditions shift), necessitating mechanisms for updating needs assessments. For Phase II's focus on scaling, the scope of Phase I needs assessments may benefit from expansion. Also, AR experience can be reviewed to identify gaps in Phase I needs assessments (e.g. more robust understanding of women's challenges).

Recommendation 4.4-B. **Identify, analyze, and communicate technology tradeoffs for specific farm, landscape, and supply chain contexts.** (See Section 4.1-A)

Observations: The Review Team did not encounter many examples of guidance to farmers or scaling partners for determining whether SI technologies should be deployed at large scale.[140] Explicit guidance was not encountered for ensuring that research protocols are screened for compatibility with: (i) site-specific agricultural and socio-economic settings; (ii) capacity of farmers to invest in technologies (e.g. water lifting); (iii) supply chains (e.g. seed supply; product marketing); or (iv) improvement of gender equity within households. While sustainability considerations certainly figure prominently in discussions of AR research protocols and technologies, it is not clear that there are mechanisms to ensure these are consistently addressed (see discussion of SIAF in Section 4.6). When AR technologies have gender equity benefits, this is heavily emphasized by researchers and partners, but otherwise gender dimensions can seem invisible (see discussion in Section 4.5).

[137] Although CGIAR, national, regional, and other partners focus on individual technologies, farmers pick and choose how they fit into the multiple goals of their integrated systems.

[138] For example, one female farmer noted that, "The biggest benefit of AR training was that it opened me to new possibilities and changed my perspectives. From these trainings, I've incorporated new vegetables, grasses (for dairy), and avocado trees (which increased income and consumption). I hire labor to help with avocado."

[139] For example, mid-season drought has emerged as a significant concern in Ghana. *IITA-led development of 'Geospatial tools for spatial targeting of sustainable intensification technologies to context.'*

[140] However, some AR research activities explore tradeoffs. For example, Birhanu et al (2019) assessed potential field- and watershed-scale impacts of soil water conservation practices based on 34 years of data on cropping practices, water consumption, etc.

Rationale: Farmers, even within the same community or agroecology, have distinct challenges and opportunities (e.g. crop response to fertilizer; access to inputs, water sources, and remunerative markets) therefore the tradeoffs of technology adoption will vary from farm to farm and over different timeframes.[141] At the same time, scattered adoption of a technology will have different implications than high adoption 'density' (e.g. effect of water extraction or storage systems on regional water resources; effect of increased crop or livestock sales on market prices). Where AR technology scaling models include a service provider model (e.g. maize shelling machines, feed mills, and forage choppers co-owned by a small farmer group), there may be gender or other equity implications to be considered (see Section 4.5-A). It would be valuable for the AR program to undertake systematic assessment and develop guidance for: (i) researchers in screening technologies for perverse sustainability outcomes if adopted at large scale; and (ii) scaling partners to optimize targeting of farmer populations for technology dissemination and capacity building.

Figure 6. Testing alternative cotton residue management in N'Goloniasso, Mali.

Recommendation 4.4-C. **Leverage existing data streams to better quantify AR potential for enhancing household income and reducing hunger and poverty.** (See Section 2.1-A, 2.2-A, 2.3-A, 3.2-A, 4.1-A, 4.2-A, 4.6-B)

Observations: Many of the AR technologies clearly demonstrate potential beyond direct improvements in crop and livestock yields and production efficiencies. For example, improvements in animal genetics, housing, feed storage, and ration formulations are perceived to be 'gateway' technologies as the focus on feeding efficiency encourages farmers to think of their farm as a business (seed multiplication may have an analogous effect). Conservation agriculture and other soil-building technologies can impact farm biomass management that can lead to improved soil fertility and farm resilience. Mechanization can enable men and women to divert labor toward activities that enhance income and nutrition. Vegetable gardens and fruit trees that target specific nutrient deficiencies can reduce household vulnerability to illness and associated costs. Some AR research focuses on landscape-scale potential for sustainable food production and gap-filling strategies (e.g. diversification; organic matter enhancement). However, the AR program relies heavily on research leaders to provide guidance regarding which technologies have high potential for reducing hunger and poverty.

Rationale: It would be valuable to systematically review existing AR technologies for their food security and income potential using existing data streams (e.g. M&E data; meta-analyses of research data; cost-benefit analyses).[142] It is possible that available data support only indicative conclusions regarding the probability of

[141] For example, Silberg et al. (2017) studied the determinants for adoption of maize-legume intercropping in Malawi, finding that smallholder who sold legumes and practiced soil fertility management were more likely to intercrop.
[142] For example, planned RHoMIS / SIAF analysis for the Ethiopian Highlands.

food security and income impacts. USAID strongly encourages an AR program-wide approach to impact assessment (i.e. standard research methodologies that also support country-specific add-ons).

Figure 7. New foods from AR technologies and new ways of preparation: Nutrition demo in Linthipe, Malawi.

Recommendation 4.4-D. **To complement endline studies, undertake targeted research focused on understanding impacts.** (See Section 1.1-A, 2.1-A, 2.3-A, 2.4-A, 3.2-A, 4.1-A, 4.2-A, 4.6-B, 5.1, 5.2)

Observations: The food security, income, and nutrition implications of AR technology adoption have not been fully documented. Some new impact assessment work is planned such as the upcoming Bioversity-led study of household nutrition outcomes associated with AR technologies and nutrition education interventions in SNNRP and Tigray regions in Ethiopia. Endline studies[143] are upcoming in Ghana, Malawi, and Tanzania with plans in place for follow-up surveys in Ethiopia and Mali. Such studies may encounter challenges in assessing impacts related to hunger and poverty reduction given that relatively few technologies and interventions focused specifically on nutrition and markets.

Rationale: The AR program would benefit from more robust impact assessment especially for non-production related Social and Human domains. Complementary studies should be designed to build upon previous and upcoming work, such as understanding the relevant institutions involved in technology scaling (c.f. Schut et al., 2019), qualitative work to better understand specific networks and institutions (e.g. information flows; collective action), and evaluating current policies affecting technology scaling and identifying potential entry points for feeding evidence into policy. Planning for upcoming activities and associated selection processes for research protocols should prioritize targeted impact studies that address Economic, Environment, Social, and Human program outcomes (see section 1.1-A).

4.5 Are the projects sufficiently addressing gender aspects in their research agenda to ensure equitable benefits from the research outputs?

Context. In Phase II, Africa RISING increased the priority placed on engagement with women in smallholder farming households and improving gender relations. The AR regional projects report on various dimensions of gender-related involvement in research and training. Surveys capture farmer reactions and preferences related to various components of AR technologies (e.g., crop varieties; livestock interventions; labor requirements) and trainings include women.

The AR program appears to emphasize gender inclusion (i.e. women benefitting from adoption of AR-validated technologies) more than gender transformation (which is a frequently articulated aspiration of the CGIAR and

[143] Endline studies are the counterpart to baseline studies.

a component of USAID-funded work on 'gender integration continuum'[144]). A gender transformative approach would include continually challenging norms that devalue women's role in farming, strengthening women's leadership and entrepreneurial skills, supporting their vocal participation in decision making forums, and ongoing measurement of the status of women's empowerment. A combined socio-technological, iterative approach, that heavily emphasizes community engagement, would be used to critically analyze and test participatory systems change models.[145]

Barriers within the CGIAR to implementing a gender transformative approach include: (i) budget and staffing that prioritize biophysical scientists;[146] (ii) concern among CG scientists that engaging in gender analysis and other qualitative methods will be negatively perceived by their disciplinary colleagues;[147] and (iii) entrenched focus on the household as the fundamental unit of analysis despite evidence that intra-household decision making powerfully influences production and consumption decisions.[148] The USAID mandate to use the SIAF made gender / social dimensions an obligatory aspect of AR activities, but effective implementation has depended on training and direct engagement with gender specialists.[149]

Recommendation 4.5-A. **Better articulate the actual and potential roles of women in AR reporting.** (See Section 3.2-B, 4.1-A)

Observations. The selection criteria and processes used to determine the inclusion of specific women and men in trainings, technology validation, and other AR activities are not clearly described in AR reporting. This is at odds with overall program guidance, which emphasizes the importance of gender, as well as with AR reporting documents that include statements like "Gender specific issues exist and merit a deeper qualitative research approach to fully understand them and make sure that policy interventions respond to gender-specific needs, such as increased access to labor-saving technology and longer maturity loans for more risk averse farmers."[150] While gender issues are commonly alluded to in AR project and program documents, the Review Team did not find that these issues are sufficiently integrated into AR reporting and program implementation.

Rationale. Gender dimensions should be clearly characterized and used to elucidate the specific roles of men and women related to each AR technology (e.g. *ex ante* evaluations). Taking stock of women's current roles in asset ownership, decision making, income generation, and labor allocation can improve detection of opportunities for more effectively engaging and empowering women farmers. AR project leaders should adapt reporting templates related to trainings, surveys, and technology evaluations to more explicitly characterize current and potential gender-specific roles (see Section 3.1-B and Appendix 8).

Recommendation 4.5-B. **Develop an improved inventory and description of women-only research groups and gender-responsive modifications of AR technologies.** (See Section 3.2-C)

Observations. Gender is an obviously important factor in smallholder adoption of AR-validated technologies. For example: (i) Women appear to be enthusiastic adopters of feed troughs for small ruminants in West Africa[151] and for dairy cattle in Ethiopia, goat intensification in Malawi, and homegardens in Mali and northern Tanzania; (ii) Men and women indicated they would direct labor savings from access to mechanized maize

[144] https://www.igwg.org/wp-content/uploads/2017/05/FG_GendrIntegrContinuum.pdf
[145] An upcoming handbook will provide guidance for gender transformative approaches.
[146] For example, gender specialist positions are often linked to soft money and socio-economic researchers commonly have their time allocated across many different projects.
[147] Gender analysis has been described as a 'scaleability accelerator' using qualitative methods that are better suited than quantitative methods at answering 'why' questions.
[148] For example, women and men within the same household might have different endowment status and restrictive household norms may inhibit women's ability to take advantage of training, implement new technologies or approaches, or capitalize on improved or diversified production.
[149] See Fischer G. 2019. Gender analysis training in Africa RISING (2015-2018). Ibadan, Nigeria: IITA.
[150] See page 25 in "Africa Research in Sustainable Intensification for the Next Generation in Ethiopian Highlands project Technical report, 01 October 2018–30 March 2019." Globally, gaps in gender-differentiated data inhibit achievement of policy goals such as the SDGs (see https://data2x.org/).
[151] Yet, they may face barriers in deriving full benefit from improved animal nutrition when they have limited market access such as in parts of northern Ghana where women must rely on male family members to market their small ruminants.

shellers to different activities;[152] (iii) In Mali, women reported that contour bunds increased shea nut yields, which enhance women's income and household nutrition; and (iv) Sharing of knowledge and resources appears to occur preferentially within, rather than across, genders.[153] However, within the AR program, assessment of gender-related dimensions does not seem to be consistently applied.

Rationale. Applying a gender lens to AR technologies would include assessing accessibility (e.g. capacity to invest in new technologies), suitability (e.g. effects on labor, income, and nutrition), and intended uses of increased income (e.g. investing in farm equipment; purchasing higher nutrition foods) or labor savings. A descriptive inventory would be a useful tool for assessing the level of effort and achievement in building gender-sensitive approaches into the AR program. It could also inform further research on gender-related factors of AR adoption and scaling.[154]

Figure 8. Adoption of a communally-owned maize sheller in Nyangua, Ghana.

SI Assessment Framework

4.6 The Sustainable Intensification Assessment Framework is relatively new, but what progress has been made in embedding its use in project / programme activities? Is this an appropriate tool for the program and how might its implementation in Africa RISING be strengthened in future?

Context. To navigate the economic, environmental, social, and human consequences of productivity-enhancing SI interventions, the AR program, in collaboration with the Sustainable Intensification Innovation Lab, has developed the Sustainable Intensification Assessment Framework (SIAF) as a tool for: (i) analyzing the relative sustainability of SI innovations by collecting data for the most relevant indicators and comparing them with the status quo; (ii) comparing performance of innovations through visualization of data on SI indicators (i.e. radar charts); and (iii) identifying potential tradeoffs and synergies from SI interventions.[155]

Application of the SIAF is intended to involve a structured stakeholder process for selecting indicators focused on two fundamental questions: (i) How sustainable is this plot / household / community in comparison with

[152] In Duko, Ghana, men indicated they would fabricate bricks and women indicate they would harvest and process shea nuts.
[153] For example, women participating in Madina Technology Park in Ghana reported they share improved vegetable seed with other women, while men reported sharing sorghum seed without other men.
[154] For example, assessing the impact of sack gardens on women's' income and household nutrition (e.g. protein, iron, zinc, vitamin A, vitamin E) with attention to the harvest timing, amount, and use (sold or consumed) of each vegetable type.
[155] There is ongoing discussion among AR program leaders regarding how SIAF analysis can serve broader impact assessment (e.g. how to compare performance across technologies, sites, and regions given that researchers can select diverse indicators for each domain; how to attribute AR technology impacts on SI domains in the context of confounding factors).

other plots / households / communities? (ii) If something is changed, does the sustainability of the plot / community / household change and, if so, in what way does it change? Applications of the SIAF might include:

- To understand overall performance of a technology or a combination of technologies;
- To understand farmer adoption of technologies (either *ex ante* or *ex post*);
- To identify conducive factors for a technology (e.g. environmental or socio-cultural suitability);
- To determine any necessary additional interventions (e.g. storage options paired with maize shellers);
- To assess system-level tradeoffs and synergies of AR technologies, across the five domains, using single or time series SIAF snapshots or hypothetical scenarios (see Appendix 7)*;* [156]
- To mainstream gender analysis (e.g. household-level benefits and labor implications of technology adoption);[157]
- To develop multi-disciplinary research questions relative to specific technologies;
- To facilitate participatory engagement in technology selection.

AR program leaders emphasize that the SIAF should not be used to drive AR activities and that it should be used for assessment of system sustainability (rather than for specific technologies or activities given the tradeoffs in combining different technologies). For example, in Ethiopia, the RHoMIS (Rural Household Multi-Indicator Survey) has been adapted to include SIAF indicators and applied to evaluate production, economic, environmental, social, and human risks at four levels of technology adoption.

Recommendation 4.6-A. **Increase training opportunities related to implementing and interpreting SIAF analyses**. (see Section 1.2-B, 2.4-A, 3.1-B, 4.4-B).

Observations. AR researchers are expected to learn and implement a culture of data-gathering, recording, and interpretation based on a deep knowledge and understanding of highly interrelated SI impact indicators. They are meant to holistically assess the performance of innovations emerging from their research in terms of the direct and indirect consequences within and across the five SI domains. Most of the activities listed in Regional Workplans for 2018/2019 have designated SIAF indicators. Based on selective review of research reports, it is not clear why certain indicators were chosen, the extent to which relevant data were collected, nor how these indicators were analyzed and interpreted in light of other activity results. The SIAF radar diagrams included in Technical Reports lack interpretation (see Section 1.1-C) regarding what was measured within each domain (i.e. indicators selected and used) and how and why changes came about.

Use of SIAF was mandated by USAID in 2017, however, early applications reflect AR researchers' unfamiliarity with the tool (e.g. tendency to select easy-to-measure indicators).[158] Program-wide training on the SIAF was provided in November 2018 and other regional training events have been held, providing additional clarity (e.g. two indicators per domain recommended to detect divergent trends).

Rationale. In addition to taking a more purposeful approach to selecting indicators, users of the SIAF should more carefully describe indicator selection rationales, data collection, analysis, and results (i.e. 'stand-alone' radar diagrams in which each domain impact is explained clearly). Program leaders perceive SIAF as a suitable tool and the SIAF has been described by some AR researchers as an important tool for working across

[156] For example, if a micro-dosing fertilizer applications and planting on a line increase maize yields by 40% but requires 20% more labor (reported by farmers in Ghana and Malawi), then SIAF could be used to estimate how this AR technology impacts the whole farm system. If a farmer says (and field measurements confirm) that this technology is applied to 50% of a farmer's maize land area, yields and labor from these fields could be used to estimate overall household production increases due to this technology, accounting for possible yield reductions due to delayed planting (shortage of labor) of other maize fields, the cost of hired labor (to assist in planting (as reported by a farmer in Tanzania), etc. Such analysis would best be done on a few farms to test the concept, the results which could make for a case study and hopefully lead to methodology that could be applied on a larger scale.

[157] For example, SIAF is being used to generate research hypotheses and to conduct research on potential and actual tradeoffs in gendered outcomes related to smallholder mechanization (e.g. maize shellers, feed mills, forage choppers). See Fischer et al, 2018.

[158] To date, the SIAF has primarily been applied at the plot level to assess productivity-focused technologies although the SIAF is intended for use at multiple scales (e.g. implications at community level; for shared natural resources).

disciplines and / or on complementary research activities,[159] however some AR researchers indicate ongoing confusion regarding SIAF application and a need for further training.[160]

More focused training and practice would build AR researchers' capacity to undertake SIAF analyses and to interpret and make use of SIAF radar charts.[161] Training would also be instrumental in helping AR researchers to integrate their research results across multiple domains (i.e. apply an SIAF lens to their analyses) even when available data do not support a full SIAF analysis (i.e. completed radar chart). Trainings could provide hands-on examples of applying the five domains to AR technologies and elucidate how impacts in one domain could impact other domains (e.g. how changes in Production, such as labor savings, affect Social and Human, such as income and nutrition; see examples in Appendix 7) to guide future research. Ideally, training would result in: (i) enhanced confidence in using SIAF indicators and methods; (ii) greater commitment to producing research analyses that integrate multiple domains; and (iii) more targeted research planning based on *ex ante* assessment of impact domains such as prioritizing research proposals with higher potential for benefits in multiple domains. Trainings could also aim to produce brief synopses of SIAF analysis for sharing with AR partners and stakeholders (see Section 2.4).

Recommendation 4.6-B. **Ensure necessary data collection to support high-priority SIAF analyses**. (See Section 1.1-A, 1.1-B, 1.2-A, 2.3-A, 2.3-B, 4.4-C)

Observation. Document reviews, KIIs, and FGDs all indicated that the AR program is generating a good deal of evidence related to one of the five SI domains (i.e. Productivity) and to a lesser extent on three of the five domains (i.e. Economics, Environment, and Human). Evidence is generally lacking for the Social domain (e.g. relationships associated with gender, social groups, collective action and the ability to resolve conflicts). AR program leaders agreed that there has been little consolidation and synthesis of SIAF-relevant data and noted that it would be valuable to identify specific types of data gaps for using the SIAF as well as strategies for filling these gaps.

Rationale. Relatively few research activities are collecting the types of data that would fully allow the tradeoff analysis that underlies the SIAF. AR research leaders should identify high-priority areas where SIAF analyses would be best applied (e.g. through focused sessions at annual planning meetings) and, based on these priorities, actively promote relevant research and data-gathering through proposal solicitation mechanisms. Appendix 7 presents examples of tradeoffs and synergies, in nine topic areas, that could provide the basis for SIAF-based assessment.

Scaling potential

4.7 Are the research outputs relevant to solve farming systems constraints beyond the Program's implementation sites and the life of the program?

Context. The AR program seeks to evaluate, document, and share experiences with delivering and integrating innovation for sustainable intensification in a way that will promote uptake beyond the AR action research sites. USAID is interested to learn from the AR program about effective processes for identifying lead technologies to promote to scale including understanding how interventions can be adapted to different types of farmers with different enabling conditions. Key questions include: (i) How should 'adoption' and 'scaling' be defined and measured for different technologies? (ii) What drives adoption and dis-adoption dynamics (e.g. enabling conditions; inter-annual variability)? (iii) Do farmers prefer single technologies or integrated solutions sets? (iv) How to attribute impact when technologies are partially adopted across farms and communities? (iv) How can adoption cases of SI innovations be effectively tracked for both direct and indirect beneficiaries?

[159] For example, USAID highlights the AR program's use of SAIF in gender-related research in Gender Integration in USAID's Agricultural Research Investments: A Synthesis of Key Findings and Best Practices. Final Report Feed the Future Advancing Women's Empowerment Program. November 2019.
[160] For example, WA scientists expressed difficulty in applying the SIAF to plot-level research and ESA scientists expressed greater ease with SIAF application at plot-level, but more difficulty at household, farming system and village levels.
[161] Several program leaders noted that further test applications of the SIAF should precede further investment in training.

Recommendation 4.7-A. **Systematically document hypotheses and evidence related to technology adoption and scaling.** (See Section 3.2-A)

Observations: The Review Team found that direct engagement farmers were forthcoming and articulate about their specific benefits and preferences for AR technologies.[162] Participatory models appear to function well (noting different approaches across countries – see Section 3.2-A) and some farmers have added their own innovations (e.g. combining animal shed and feed storage functions with the AR-promoted feed trough in Emba-hasti, Ethiopia). AR partners and direct engagement farmers commonly referred to 'farmer-to-farmer exchange' however mechanisms were not well described. When asked by the Review Team, farmers mentioned one-to-one seed exchanges or hiring neighbors who had been trained to construct animal feeding structures, as well as farmers who stop by Tech Parks or their own fields to ask about AR technologies. When asked about specific examples of technologies adopted in non-target communities, answers tended to be ambiguous. Mechanisms and venues for farmer information exchange appear to reflect socio-cultural norms (with gendered implications for information access – see Section 4.5-A).[163] Structured AR mechanisms for farmer participation are unique in some places, but in others are complementary to existing farmer organizations (e.g. seed multiplication cooperatives in Ethiopia).

Figure 9. Farmer adaptation of feed storage and feed trough structures and management in Emba-Hasti, Ethiopia.

In the transition to Phase II, there have been efforts to define impact pathways and partnerships that would allow innovations to extend beyond research sites.[164] For example, a new ET-AR protocol, Multi-Stakeholder Innovation Platforms for Scaling Sustainable Intensification Innovations, is reviving Innovation Platforms to build scaling capacity and leadership among multiple actors with varied backgrounds (including extension systems, NGOs, public flagship projects, farmers' organizations, and research institutions) with a focus on seed multiplication systems, crop production, and feed / forage.

Examples of 'vertical' scaling were encountered including policy-focused evidence gathering (e.g. fertilizer recommendations; soil and water conservation programs) and capacity building for organizations with broad geographic reach (e.g. train-the-trainer activities, guidance manuals).

[162] For example, when asked which AR technologies would be the easiest to scale, farmers in Ethiopia indicated that high demand for forages would enhance scalability for related technologies (i.e. improved varieties, feed troughs) if barriers could be overcome (i.e. seed access, financing for trough construction).

[163] In West Africa, men indicated they have greater mobility and have opportunities to discuss farming innovations at public venues. In Ethiopia, both men and women noted sharing farming information during observance of religious holidays. In some West African AR sites, it was noted that women cannot sell livestock in a public market and must rely on male relatives to handle these transactions.

[164] Researchers did indicate that many scaling partnerships were opportunistic (e.g. in-region partners with third-party funding.

Rationale: AR impact depends, in large part, on 'horizontal' scaling models in which wider adoption will flow from demonstration of AR technologies on Tech Parks and target farmers' fields (i.e. farmers can visually assess their potential). More clearly documenting the underlying hypotheses (i.e. making assumed mechanisms explicit) is necessary to seek evidence about whether and how these mechanisms are functioning in practice. While less prevalent than horizontal scaling approaches, vertical scaling activities may lead to much broader adoption of AR technologies and more widespread progress toward sustainable intensification. A more systematic approach to assessing potential impact should be anchored in the relevant scaling literature.[165] Relatedly, AR project and program leaders should prioritize tracking of technology dissemination, adoption,[166] and adaptation.

Recommendation 4.7-B. **Revisit capacity building and backstopping requirements and develop exit strategies for partnerships and target sites.** (See Section 3.1-A)

Observations: Across different AR countries, the Review Team noted different perceptions about the CGIAR's role in scaling[167] and this was reflected in staffing models for AR action research sites (e.g. in Ghana and Ethiopia, site coordinators are AR staff[168]; in Mali, they are NGO partner staff[169]). Regardless of the staffing model, the site coordinator is clearly a foundational role requiring talented, multi-faceted professionals capable of managing a wide range of technical, communications, logistical, relationship management, and oversight functions.

At the Phase II design stage, some AR researchers were aware that achieving scaling objectives would require them to provide more than knowledge transfer and technical backstopping, however USAID indicated an intention to fund only limited capacity building. At nearly every site visit, the Review Team heard strong requests from farmers for additional support with accessing improved seeds and other inputs in larger volumes as well as accelerated access to technical assistance (e.g. tracing contour lines for implementing contour bunds).

Rationale: The AR program's engagement standards specify that "researchers must ensure a smooth conclusion of the engagement by involving the key stakeholders," including timely communication and mutual agreement about completion processes with partners and farmers (possibly including compensation for any negative effects).[170] With the AR program scheduled to end within a few years, AR research leaders should develop and begin implementing exit strategies that emphasize: (i) getting existing partners ready to take over all appropriate project roles;[171] (ii) bringing in new partners to fill specific functions; and (iii) communicating with partners, staff, and beneficiaries about which project components will continue and which will come to an end.

Completing validation and packaging of technologies as 'ready made' solutions for scaling partners will be necessary. This may imply tapering down funding of new research protocols and ramping up delivery of trainings, preparation of guidance manuals, and outreach to public and private sector stakeholders as well as greater emphasis on synthesis activities that generate transferrable insights to local, national, and international development organizations. Several AR researchers and partners suggested that the AR program

[165] As one example, see Stringer LC, Fraser EDG, Harris D, et al. 2019. Adaptation and development pathways for different types of farmers. CCAFS Working Paper no. 270. Wageningen, the Netherlands: CGIAR-CCAFS.

[166] For example, technology practice maps could be overlaid with maps of land use, household size / land areas, and other GPS layers to assess the spatial dimensions and farmer types (e.g. food secure / insecure) associated with AR technology adoption. For example, a 'marker' could accompany improved seeds or tree seedlings, enabling spatial tracking.

[167] For example, AR researchers in in Mali explicitly restrict their role to undertaking research and backstopping technology scaling, while relying on NGO partners for day-to-day engagement with farmers (much of which is funded by USAID Mission funded "Africa RISING" scaling project). (See Section 3.1-A, 4.7-B)

[168] In Ethiopia, important coordination roles are played by government at kebele, woreda, and district level.

[169] Until two years ago, site coordinators in Mali were staff of ICRISAT, which is a sub-contractor of IITA, the lead center for AR-WA.

[170] Africa RISING. 2015. Engagement standards in participatory research for the Africa RISING Program. Nairobi, Kenya: ILRI.

[171] This includes multi-year research projects such as the AR-ICRISAT trial in Mali on sorghum variety responses to soil organic and inorganic amendments in three different agro-climatic regions; currently in its third year, trial results will be analysed using (i) APSIM (The Agricultural Production Systems sIMulator) and (ii) DSSAT (Decision Support System for Agro-technology Transfer) models. Field trials should be continued for at least 4 to 6 years to effectively investigate the stability of crop responses to soil amendments.

should plan large closing meetings to hand off technology packages to scaling partners and optimize ongoing engagement among in-region partners.

Recommendation 4.7-C. **Document and evaluate different Tech Park models used in AR regional projects.**

Observations: While they are fundamentally similar (i.e. sites for undertaking farmer-engaged, multi-disciplinary field trials and hosting field days), the Tech Parks in Ghana and Mali and Farmer Training Centers (FTCs) in Ethiopia have important conceptual and practical differences.[172] Through the farmer field visits, the Review Team noted variation in farmers' perceptions and sense of ownership about the Tech Park / FTC in their community (e.g. divergent perceptions between researchers and farmers about the benefits of Tech Parks;[173] different degrees of access to Tech Parks beyond the small number of direct engagement farmers). It is not clear how tracking numbers of non-target farmers exposed to AR technologies (e.g. at field days, through 'drop by' visits to Tech Parks and farmer field trials) translates to estimates of technology adoption. In ESA, where mother-and-baby trials are the predominant model, opportunities for farmers to observe and learn from AR activities are different than in the other regions.

At all sites, the Review Team encountered high levels of enthusiasm among direct engagement farmers, who clearly articulated specific benefits and challenges for their farming operations and their households (see Section 4.4-A). It seems that different types of farmer participatory decision making are at work across AR countries, ranging from annually re-visiting farmer priorities to inform that year's activities to relying on Phase I needs assessments as the touchstone for researchers to offer a set of technologies from which farmers could select their preferences.

Rationale: The Tech Park and FTC models are central to the scaling strategies used by the WA and ET regional projects, respectively, and is considered a successful innovation by partners.[174] They provide a platform for AR research partners to conduct the long-term, multi-location research that provides critical agronomic information for scaling AR technologies. Therefore, it makes sense to direct explicit attention to describing how they are sited, managed, and resourced, as well as who gains access and benefits (e.g. consumption or sale of feed or food; use of water and equipment). The mother-and-baby trial model in ESA will offer different advantages and disadvantages (regarding access of non-participating farmers, potential for long-term research, etc.) Without clearly describing the selected (or *de facto*) model, it will be difficult to decipher clear messages about their effectiveness. The apparent variation in farmer participatory models also offers an opportunity for cross-country comparisons (e.g. different levels of adoption; participation by women) and learning.

5. Alignment with donor and country development strategies

This section describes findings regarding the alignment of the AR program with donor and country development strategies and identifies gaps, weaknesses, and solutions.

[172] In Ghana, Tech Parks are located within direct engagement villages on land allocated by community leaders for AR field trials, which are implemented by local farmers (with support by on-site AR technicians). In Mali, Tech Parks are located in the general vicinity of direct engagement villages. In both countries, these Tech Parks were established in the context of the AR project. In Ethiopia, FTCs are pre-existing community resources that the AR project makes use of through its partnerships with governments.
[173] For example, in Mali, women vegetable growers heavily emphasized access to a dry season water source as the key Tech Park benefit (and advocated strongly for this water access to be dramatically expanded), while researchers emphasized improved variety trials. While both benefits are being delivered, it is important to note the difference in what is valued by the beneficiaries and researchers. This is one dimension of a larger theme: direct engagement farmers emphatically calling for expanded access to inputs and technology that are only available in the context of a research activity (which is inherently small-scale and of limited duration).
[174] For example, AR researchers noted that it had been adopted by CORAF in West Africa.

Contribution to development objectives and to agricultural policy

5.1 Assess the Program's alignment with and contribution to relevant USAID Missions' and countries' development objectives.

Context. Since Phase I, AR leadership has actively engaged at the sub-national and national levels to cultivate essential government support. AR researchers are collaborating with government to develop and validate technologies that contribute to national agricultural development objectives.[175] The AR Communications Team engages with USAID Missions on a case-by-case basis (e.g. last year two batches of technical briefs were produced for the Mission in Ghana) and in response to periodic requests from Missions and also provides materials (e.g. country briefs on all the technologies validated in AR countries). They indicate that Mission staff commonly have low familiarity with centrally funded USAID projects. AR researchers also develop concept notes and provide presentations to familiarize Mission staff with the AR work.

Recommendation 5.1-A. **Collaborate with Washington DC-based USAID partners to identify entry points in national policy and at USAID country-based Missions for scaling AR-generated knowledge and technologies.** (See Section 3.3-A, 3.3-B)

Observations: Given the dynamic nature of policy 'windows of opportunity,' entry points to agricultural policy processes are identified opportunistically, relying on the network and ambition of specific AR researchers (who may be taking professional risks in promoting evidence-based information that challenges conventional wisdom or programs that have existing constituencies).

USAID Missions have provided funding to scale AR technologies, although support has varied significantly across AR countries.[176] This is attributed to inherent variation among Missions in terms of development priorities and the interests and motivation level of individual staff, as well as high turnover of Mission staff. AR regional projects seeking Mission support should anticipate the need to cultivate greater understanding of the relevance of agricultural research to the overall development agenda (and specific Mission priorities). At the same time, it may be that Mission support will be forthcoming when priorities happen to align (e.g. promoting cowpea in Ghana; scaling sorghum, vegetables, and livestock technologies in Mali; GRAD activities in Ethiopia). Feedback from Mission partners suggest that:

- Key strengths of the AR program include: (i) researchers developing locally relevant solutions in close contact with smallholder farmers, instead of formal trials and pre-packaged technologies,[177] which can be misinterpreted by Extensionists; (ii) collaboration with national research institutions, Extension, and community-level agriculture advisors and alignment with national priorities;[178] (iii) holistic approach that includes agronomic information for multi-crop systems and addresses cost-benefit analysis, market systems, and social dimensions; (iv) effective interaction between Mission staff and in-country AR researchers.
- Perceived challenges of working with the AR program include: (i) inherent limits in the number of available CG researchers slows progress and increases dependence on national research institutes and host governments to carry out implementation; (ii) discontinuities across USAID headquarters, AR program headquarters, and local AR implementers (e.g. delayed budget transfers to local partners; infrequent visits from DC-based USAID counterparts; weak access to technical reports).

[175] For example, in Ethiopia, the Ministry of Agriculture and the AGP (national growth program) have supported CIMMYT-led work on mechanization for scaling with micro-finance institutions and service providers / leasing companies. IWMI-led work on solar pump technologies is being scaled in 16 districts through partnership with the Agricultural Transformation Agency (ATA).
[176] Missions have supported AR scaling in Mali, Tanzania, Malawi and Zambia.
[177] Mission contacts noted that some AR technologies were not new, but that AR added value by helping to "put the right technology in the right place" (i.e. locally appropriate combinations of crops and practices).
[178] For example, focusing on government approved technologies and ensuring approval from the agriculture ministry (as contrasted with some NGOs that have bypassed slow-moving government approval processes and promoted non-approved technologies, risking incompatibility with farmers' needs and local agroecologies).

Rationale: If the policy implications of AR technologies can be identified through a more structured process and advanced in policy dialogues by a consortium of actors (e.g. AR researchers and their partners, USAID Mission, USAID BRFS, and other global donors), they may be more likely to gain visibility and positive attention, with lower burden on individual researchers. Emerging USAID-brokered regional coordination mechanisms[179] may offer an efficient mechanism for AR project and program leaders to communicate about the potential impact of innovative technologies as well as insights about scaling within the regional context. (See Section 1.4-B)

Pursuing opportunities with USAID Missions will depend on DC-based USAID partners building relationships and making the case that AR projects can offer relevant technical support (which is not always recognized within Missions). It would be inefficient and ineffective for individual programs such as Africa RISING, that are centrally funded by USAID, to each approach the Missions.[180] It does make sense for AR leaders to continue basic outreach such as inviting Mission staff to participate in relevant AR events and communicating about AR outputs with links to Mission priorities.

Recommendation 5.1-B. **Continue to nurture collaborations on shared priorities with sub-national units of government.**

Observations: In AR target districts, AR researchers and staff engage with local government, primarily Ministry of Agriculture units and Extension staff. Across the three AR regions, these local government partners range widely in their capacity and interest to contribute to AR activities, although most are eager to secure resources to support basic functions such as office facilities and transportation.

Rationale: Relationships with government are essential to AR projects' 'license to operate' in target areas. Local government partners are an important source of continuity for AR technologies and knowledge.

Figure 10. Seed multiplication group of extension agents and farmers in Rhotia Khaina, Tanzania.

5.2 Assess to what extent the Program has made contributions to the agricultural policy process and debate in the country (e.g., varietal release, recommendations adopted by the government)

Context. Collectively, AR-participating CGIAR centers have networks that extend into agricultural policy arenas. Regional AR projects have worked to inject research-based knowledge into policy processes related to national fertilizer policies and soil and water conservation. In Ghana, the AR project responded to a policy initiative

[179] In West Africa, a coordination hub centered in CORAF may become a unified voice for USAID-funded research in the region. A similar possibility may materialize with ASARECA in East Africa.

[180] USAID Mission priorities and funding decisions occur within a complex context in which international consulting firms manage large USAID implementation contracts and national governments help to shape donor funds are used.

promoting blended fertilizers by undertaking field trials for use in maize production. In Mali, where nationally recommended fertilizer rates for vegetable production are extremely high, AR researchers collaborated with IFDC to test the viability of deep fertilizer application to reduce total fertilizer use and cost. In Ethiopia, AR researchers networked diligently to insert AR-gathered evidence on spatially heterogeneous crop response to fertilizer applications into the national integrated fertility guidance. In Ethiopia, AR analysis is documenting the impacts of the long-term, nationwide Sustainable Land Management Program (SLMP).

Recommendation 5.2-A. **Focus policy engagement on shifting system-level bottlenecks to sustainable intensification, such as seed systems and fertilizer policy.** (See Section 3.1-D)

Observations: While the policy context influences many aspects of agricultural systems, the issue most frequently and energetically raised in farmer field visits was weak access to improved seeds including early generation seed for seed multiplication initiatives. With AR research activities heavily emphasizing field trials for improved crop and fodder varieties (as well as some seed multiplication projects), seed 'bottlenecks' can significantly inhibit progress toward adoption at scale. In many African countries, national seed registration systems have limited capacity to produce basic seed, leaving cooperatives and private companies unable to undertake the seed multiplication that would profitably increase availability of improved seeds. While efforts to engage private sector agrodealers are important, it is unlikely that robust seed distribution systems for improved varieties and alternative crops will emerge without public sector action (e.g. legal reforms; well-targeted and timebound subsidies).

Rationale: Policy-based scaling strategies offer the possibility of very large impact,[181] but are dependent on identifying windows of opportunity, mobilizing robust political networks and strategic private sector partnerships, and dedicating significant time. Where AR leaders and researchers decide to invest in policy outreach, they can:

- Spotlight where progress has happened and where further progress is stymied by current arrangements.
- Emphasize potential impacts for national development agendas (e.g. converting improved yield estimates into national improvements in economic activity, nutrition, natural resource condition, climate resilience, and other SDG-related concerns).
- Promote AR-generated solutions through USAID-convened stakeholder dialogues that engage key seed system actors (e.g. farmers' unions and cooperatives, national agencies, and seed companies).
- Investigate alternative models from other national contexts and development programs and propose pilot efforts to adapt in AR countries.

[181] Highly visible research-to-policy initiatives may also be more likely to leverage in third-party investment (e.g. fertilizer policy work in Ethiopia).

Appendix 1: List of key materials reviewed

Materials reviewed
Africa RISING Program Overview. (Concise summary of programmatic / governance structure)
Africa RISING West Africa Project 2018/2019 Workplan. (Two-year workplans for Ghana and Mali)
Africa RISING West Africa Technical Report April-September 2018. (Semi-annual technical report for Ghana and Mali)
Africa RISING West Africa Technical Report October 2018 – March 2019. (Semi-annual technical report for Ghana and Mali)
Africa RISING East and Southern Africa Project 2018/2019 Workplan (Sections related to Malawi and Tanzania)
Africa RISING East and Southern Africa Technical Report April-September 2018. ((Sections related to Malawi and Tanzania)
Africa RISING East and Southern Africa Technical Report October 2018 – March 2019 (Sections related to Malawi and Tanzania).
Africa Rising Program Data Management Plan (2019-2021)
Africa RISING West Africa Project: Phase II Project Logframe, July 2017
Africa RISING East and Southern Africa Project: Phase II Project Logframe, July 2017
Africa RISING. 2018. Footprints of Africa RISING. Phase I: 2011–2016. International Institute of Tropical Agriculture, Ibadan and International Livestock Research Institute, Addis Ababa.
Africa RISING. 2016. Evidence Brief: Comparison of statistical and participatory clustering of smallholder farming systems. A case study in northern Ghana.
Africa RISING. 2015. Engagement standards in participatory research for the Africa RISING Program. Nairobi, Kenya: International Livestock Research Institute.
Ayantunde et al, 2019. Effects of feed and health interventions on small ruminant production in mixed crop-livestock systems in Southern Mali. (Focused on small ruminants, livestock numbers, mixed farming, household food security, Sahel)
Birhanu et al. 2019. A watershed approach to managing rainfed agriculture in the semiarid region of southern Mali: integrated research on water and land use. Environ Dev Sustain, 21:2459–2485. (Example of landscape-scale analysis in the AR program)
Ellis-Jones J, Okali C, Agyemang K. 2014. Africa RISING West Africa Project External Mid-Term Review Report. (Evaluation focused on the 2014-16 work plan for West Africa, which incorporated activities undertaken in 2013)
Fischer G. 2019. Gender analysis training in Africa RISING (2015-2018). Ibadan, Nigeria: IITA.
Fischer G, Wittich S, Malima G, Sikumba G, Lukuyu B, Ngunga D, Rugalabam J. 2018. Gender and mechanization: Exploring the sustainability of mechanized forage chopping in Tanzania. Journal of Rural Studies, 64:112-122.
IFPRI, ILRI, IITA. 2012. Africa RISING Program Framework 2012 – 2016. (Underlying principles, program outcomes, and implementation plan for the three regional projects in Phase I)
IFPRI, ILRI, IITA. 2016. Africa RISING Program proposal for a second phase, 2016–2021. (Detailed description of theory of change, approach, and program-wide implementation strategy for Phase II)
ILRI. 2016. Africa RISING Ethiopian Highlands Regional Project: Proposal for a second phase, 2016 – 2021. (Theory of change, approach, and implementation strategy for Phase II in the Ethiopian Highlands)
IFPRI. 2016. Africa RISING Monitoring and evaluation scope of work for Phase II (2016-2021). (Phase II M&E-related activities complemented by description of M&E-related tasks accomplished in 2011-15)
IFPRI. 2019. Africa RISING Data Management Plan. (Guidelines on for use in 2019-2021)
IFPRI. 2019. Africa Research in Sustainable Intensification for the Next Generation (Africa RISING) Program: Location of Action Research Target Sites.
IITA. 2019. Africa RISING Program Communication and Knowledge Management Strategy 2019–2021. (Reference document for all Communication and Knowledge Management approaches and tools)
IITA. 2017. Africa RISING West Africa Project: Phase II Project Logframe. (Region description, impact targeting, theory of change, and logframe for West Africa)
IITA. 2016. Africa RISING East and Southern Africa Regional Project: Proposal for a second phase, 2016 – 2021 (Sustainable Intensification of Key Farming Systems in East and Southern Africa). (Detailed description of theory of change, approach, and implementation strategy for Phase II in East and Southern Africa)
IITA. 2017. Africa RISING East and Southern Africa Project: Phase II Project Logframe.

IITA. 2016. Africa RISING West Africa Regional Project: Proposal for a second phase, 2016 – 2021 (Sustainable Intensification of Key Farming Systems in the Guinea - Sudano Sahelian Zone of West Africa). (Detailed description of theory of change, approach, and implementation strategy for Phase II in West Africa)
Kuivanen et al. 2016. Characterising the diversity of smallholder farming systems and their constraints and opportunities for innovation: A case study from the Northern Region, Ghana. NJAS - Wageningen Journal of Life Sciences, 78: 153–166
Mekonnen et al. 2019. Determinants of survival and growth of tree Lucerne (Chamaecytisus palmensis) in the crop-livestock farming systems of the Ethiopian highlands. Agroforest Syst, 93:279–293. (Example of how AR researchers describe selection of direct engagement farmers)
Musumba, M., Grabowski, P., Palm, C. and Snapp, S. 2017. Guide for the sustainable intensification assessment framework. Kansas, USA: Kansas State University. (Indicators for researchers assessing the relative sustainability (for smallholders) of an innovation across five AR domains; not specifically designed for project evaluation)
Musumba, M., Grabowski, P., Palm, C. and Snapp, S. 2017. Sustainable Intensification Assessment Methods Manual (Working Draft). Kansas, USA: Kansas State University (Methodological guidance to researchers on estimating the indicators and metrics at multiple spatial scales)
Pound B, Tolera A, Matsaert H. 2015. Report of the internally-commissioned external review of the Africa RISING project in the Ethiopian Highlands. (Detailed evaluation focused on the 2014-16 work plan for the Ethiopian Highlands, which incorporated activities undertaken in 2013)
Signorelli et al., 2016. Typology characterization of farmers in Africa RISING sites in Mali.
Signorelli et al., 2016. Typology characterization of farmers in Africa RISING sites in Ghana
Signorelli et al., 2016. Typology characterization of farmers in Africa RISING sites in Ethiopia
USAID. 2019. Gender integration in USAID'S agricultural research investments: a synthesis of key findings and best practices – Final report. Washington, DC: USAID Feed the Future Program.
USAID Private-Sector Engagement Policy

Appendix 2: Templates used for Key Informant Interviews

Interviewee name:
Interviewee title / role:
Date:
Interviewer name:

This template is designed to elicit 'organic' input on a structured set of topics through 30-45 minute phone-based or face-to-face interviews. The purpose is to gather diverse perspectives about the Africa RISING program from a representative set of partners.

Note: Begin the interview with a brief summary of why Africa RISING commissioned this evaluation: to provide feedback to program management on how best to build on current the strengths and overcome challenges so as to enhance program outcomes. To achieve this evaluation goal, their candid discussion would be most appreciated.

Operational aspects

Inquire about partner roles, how they are supported, and frequency / types of interactions. Elicit specific examples (e.g. workshops, publications, trainings, field trials) and specific recommendations to enhance the program.

Notes

Successes

Inquire about what has worked well in the Africa RISING program (e.g. what they are most proud of) and any specific examples effectiveness or high impact.

Notes

Challenges

Inquire about what they find most challenging in their partnership with Africa RISING) and elicit specific examples of missed opportunities, structural challenges, etc.

Notes

Appendix 3: List of individuals consulted

Key Informant Interviewees

Name	Title / affiliation	Geographic base
Jerry Glover	Senior Sustainable Agricultural Systems Advisor, USAID Bureau for Food Security	Washington DC
Bernard Vanlauwe	Director for NRM & Central Africa Hub IITA / alternate Chair of Africa RISING Program Coordination Team	Nairobi, Kenya
Siboniso Moyo	ILRI Director General's representative in Ethiopia / alternate Chair of Africa RISING Program Coordination Team	Addis Ababa, Ethiopia
Carlo Azzarri	Scientist, IFPRI / Lead, Africa RISING M&E and Data Management	Rome, Italy
Jonathan Odhong	Communication and Knowledge Sharing Coordinator, Africa RISING Program	Ibadan, Nigeria
Beliyou Haile	Data management, IFPRI	Washington DC
Arkadeep Bandyopadhyay	Data management, IFPRI	Washington DC
Irmgard Hoeschle-Zeledon	Manager, Africa RISING ESA & WA Projects	Ibadan, Nigeria
Sieglinde Snapp	Co-lead, Africa RISING component in Malawi	East Lansing, MI, USA
Regis Chikowo	Co-lead, Africa RISING component in Malawi, MSU	Lilongwe, Malawi
Peter Thorne	Manager, Ethiopian Highlands Project	UK
Kindu Mekonnen	Chief Scientist, Ethiopian Highlands Project	Addis Ababa, Ethiopia
Seid-Ahmed Kemal	Pulse pathologist, ICARDA	Rabat, Morocco
Tilahun Amede	Principal Scientist / country representative, ICRISAT (system agronomy)	Addis Ababa, Ethiopia
Mestawet Gebru	Research fellow, Bioversity International (nutrition)	Addis Ababa, Ethiopia
Fred Kizito	Chief Scientist, Africa RISING Project in West Africa / CIAT	Tamale, Ghana
Bekele Hundie Kotu	Socio-economic researcher, Africa RISING Project in West Africa	Tamale, Ghana
Benedict Boyubie Ebito	Regional monitoring specialist, Africa RISING Project in West Africa	Accra, Ghana
Gideon Owiredu	Municipal Director, Ministry of Food and Agriculture,	UER, Ghana
Michael Abberton	Deputy Chair, Africa RISING WA Steering Committee / IITA	Ibadan, Nigeria
Ramadjita Tabo	PI, Africa RISING component in Mali / Director, West and Central Africa, ICRISAT / PSC member, AR-WA	Bamako, Mali
Birhanu Zemadim	Coordinator, Africa RISING component in Mali / ICRISAT	Bamako, Mali
Felix Badolo	Economist / M&E specialist, Africa RISING Project in West Africa / ICRISAT	Bamako, Mali
Jean-Baptiste Tignegre	Scientist, World Vegetable Center	Bamako, Mali
Peter Ballantyne	Principal Investigator, Communications and Knowledge Management, ILRI	UK
Kifle Woldearegay	Professor, Science and Technology, Mekele University	Mekele, Tigray
Mateete Bekunda	Chief Scientist, Africa RISING Project in East and Southern Africa / IITA	Arusha, Tanzania
Patrick Okori	Team leader, ICRISAT (plant breeding; crops)	Dodoma, Tanzania
Gundula Fischer	Gender Specialist, IITA	Arusha, Tanzania
Julius Manda	Agricultural Economist, IITA	Arusha, Tanzania
Lieven Claessens	Farming Systems Specialist, IITA	Arusha, Tanzania
Anthony Kimaro	Country Representative in Tanzania, ICRAF (soils)	Dodoma, Tanzania
Christian Thierfelder	Principal Research Scientist, CIMMYT (conservation agriculture)	Zimbabwe
Chifuniro Mankhwala	Project facilitator, CIAT (economics)	Lilongwe, Malawi

Name	Title / affiliation	Geographic base
Munyaradzi Mutenje	Agricultural economist, CIMMYT	Zimbabwe
Jeroen Groot	Associate Professor, Wageningen University (farming systems)	The Netherlands
Bruce Sosola	Climate Change Specialist, USAID Mission-Malawi	Lilongwe, Malawi
Judith Kitivo	Horticulture Specialist, USAID Mission-Tanzania	Dar es Salaam, Tanzania
Victor Manyong	Director, IITA Eastern Africa Hub / Chair, ESA Project Steering Committee	Dar es Salaam, Tanzania
Felix Chipojola	National Research Coordinator, Bvumbwe Agricultural Research Station / ESA Project Steering Committee	Limbe, Malawi
Richard Museka	Project Manager, Total Land Care	Lilongwe, Malawi
James Flock	Chief of Party, NAFAKA Cereal Market System Development	Mbeya, Tanzania
Elirehema Swai	Principal Agricultural Officer, Tanzania Livestock Research Institute (soil science)	Dodoma, Tanzania
Wezi Mhango	Professor, LUANAR (crops / agronomy)	Lilongwe, Malawi
Fanny Chigwa	Professor, LUANAR (animal health)	Lilongwe, Malawi
Josephine Ng'ang'a	Program Leader, RECODA (Kilimo Endelevu)	Karatua, Tanzania
Caleb Massam	Program Officer, RECODA (Kilimo Endelevu)	Karatua, Tanzania
Silvester Masanja	Project Manager, RECODA (Kilimo Endelevu)	Karatua, Tanzania
Ayesiga Buberwa	Program Manager, Islands of Peace (Kilimo Endelevu)	Karatua, Tanzania
Juma Mchinja	Project Officer, MNWAIA-Arusha (Kilimo Endelevu)	Karatua, Tanzania
Watanga Chacha	CEO, Meru Agro-Tours & Consultants Co. Ltd (MATC)	Arusha, Tanzania

Focus Group Discussion participants

Name	Title / affiliation	Location
Albert Berdjour	Technician, Africa RISING Project in West Africa	UER, Ghana
Roger Awopone	Technician assistant, Africa RISING Project in West Africa	UER, Ghana
Mark Kofi Bukari	Technician assistant, Africa RISING Project in West Africa	UER, Ghana
Paul Zaato	World Vegetable Center	UER, Ghana
Joshua Adda	BS student, University for Development Studies (UDS) - Animal health	UER, Ghana
Mahama Saaka	UDS - Nutrition	UER, Ghana
Fuseini Salifu	World Cover	UER, Ghana
Salifu Radiu	World Cover	UER, Ghana
Martin Seguri	Nyangua AR farmers group, Lead farmer	UER, Ghana
Dokurugu Fusseini	Site Coordinator, Africa RISING Project in West Africa	NR, Ghana
Simane Dawuda	Technician assistant, Africa RISING Project in West Africa	NR, Ghana
Mustapha Mohammed	Technician assistant, Africa RISING Project in West Africa	NR, Ghana
Antwi Ohene	Kwame Nkrumah University of Science and Technology (KNUST)	NR, Ghana
Sadat Salifu	Animal Research Institute (ARI)	NR, Ghana
Williams Atta Krah	SARI	NR, Ghana
Ernestina Annan	MS student, Kwame Nkrumah University of Science and Technology (KNUST)	NR, Ghana
Terry Ansah	University for Development Studies (UDS) - Animal health	NR, Ghana
Addah Wesseh	University for Development Studies (UDS) - Animal health	NR, Ghana
Sulleyman W. Kassim	MS student, University for Development Studies (UDS) - Animal health	NR, Ghana
Aminou Ousmane	Kpataribigou farmers Group, Assembly Man	NR, Ghana
Issah Mohammed Sani	Duko farmers Group, Lead Farmer	NR, Ghana
Yakubu Abdul Rahaman	Tibali Farmers Group, Lead Farmer	NR, Ghana
Fuseini A Majeed	Tingoli Farmers Group, Lead Farmer	NR, Ghana

Name	Title / affiliation	Location
Wilhelmina Ofori-Duah	Communications specialist, Africa RISING Project in West Africa	Tamale, Ghana
Nurudeen Abdul Rahman	Agronomist, (IITA), Africa RISING Project in West Africa	Tamale, Ghana
Al-Hassan Amadou	SEEDPAG	Tamale, Ghana
Wilson Agyare	Dean, Kwame Nkrumah University of Science and Technology (KNUST)	Tamale, Ghana
John Nzungize	Senior Project Manager / Technology Uptake Specialist / ARDT leader, Africa RISING Project in West Africa / ICRISAT	Bamako, Mali
Baloua Nebie	Breeder, Africa RISING Project in West Africa / ICRISAT	Bamako, Mali
Karamoko Traore	Scientific officer, Africa RISING Project in West Africa / ICRISAT	Bamako, Mali
Karamoko Sanogo	Scientific officer / PhD student, Africa RISING Project in West Africa / ICRISAT	Bamako, Mali
Agathe Diama	WA Head of Communications, ICRISAT -- attends field days, writes AR stories for Happenings	Bamako, Mali
Matthew Akinseye Folorunso	Post-doc, Africa RISING Project in West Africa / ICRISAT	Bamako, Mali
Madina Diancumba	Research scholar / PhD student, Africa RISING Project in West Africa / ICRISAT / University de Bamako	Bamako, Mali
Mamourou Sidibe	Scientific officer, Africa RISING Project in West Africa/ICRISAT	Bamako, Mali
Cheick O Dembele	PhD student, Africa RISING Project in West Africa / ICRISAT	Bamako, Mali
Raky Diallo	Nutritionist, World Vegetable Center	Bamako, Mali
Honafing Diarra	Scientific officer, World Vegetable Center	Bamako, Mali
Bouba Traore	Scientist, Institut d'Economie Rurale (IER)	Bamako, Mali
Harouna Yossi	Center Director, Institut d'Economie Rurale (IER)	Bamako, Mali
Hamidou Nantoume	Scientific Director, Institut d'Economie Rurale (IER)	Bamako, Mali
Mama Kone	Lead, Soils & Analysis units, Institut d'Economie Rurale (IER)	Bamako, Mali
Mamoutou Koureissi	Lead, Agro-Climatology unit, Institut d'Economie Rurale (IER)	Bamako, Mali
Cheick Hamala Diakite	Lead, GIS & Remote Sensing unit, Institut d'Economie Rurale (IER)	Bamako, Mali
Omar Samake	Acting Director, Association Malienne d'Eveil et de Développement Durable (AMEDD)	Koutiala, Mali
Mamadou Dicko	Research director, Association Malienne d'Eveil et de Développement Durable (AMEDD)	Koutiala, Mali
Siaka Coulibaly	Responsible administratif & GRH, Association Malienne d'Eveil et de Développement Durable (AMEDD)	Koutiala, Mali
Dramane Koita	Conseiller projet, Association Malienne d'Eveil et de Développement Durable (AMEDD)	Koutiala, Mali
Toumani Sidibe	AR focal point, Bougouni, Association Malienne d'Eveil et de Développement Durable (AMEDD)	Koutiala, Mali
Birhan Abdulkadir	Research officer, data management and field research, ILRI	Addis Ababa, Ethiopia
Hadia Seid	ICRAF	Addis Ababa, Ethiopia
Meron Tedesse	CIAT (new to AR?)	Addis Ababa, Ethiopia
Melkamu Bezabih	ILRI, Livestock feed and forage development	Addis Ababa, Ethiopia
Haimanot Seifu	Africa RISING communication	Addis Ababa, Ethiopia
Wuletaw Abera	Technical advisor, Landscape management, CIAT	Addis Ababa, Ethiopia
Aberra Adie	ILRI, Livestock feed and forage development	Addis Ababa, Ethiopia
Lulseged Tamene	Senior Scientist, Country representative for CIAT	Addis Ababa, Ethiopia
Million Getnet	ILRI, Multi-stakeholder platform specialist	Addis Ababa, Ethiopia
Amara Haileslassie	Agricultural water management, IWMI (solar pumps)	Addis Ababa, Ethiopia
Walter Mupangwa	Cropping systems agronomist, CIMMYT (mechanization)	Addis Ababa, Ethiopia
Mezegebu Getnet	ICRISAT	Addis Ababa, Ethiopia

Name	Title / affiliation	Location
Peter Ballantyne	ILRI consultant (communications, etc)	Addis Ababa, Ethiopia
Ermiyas Mekonnen	ILRI	Addis Ababa, Ethiopia
Mohammed Ebrahim	Africa RISING Site coordinator Maichew, Tigray	Maichew, Ethiopia
Haftu Kedene	Office of Agriculture -- Ofla woreda	Maichew, Ethiopia
Asefa Assres	Crop and irrigation expert, Office of Agriculture	Maichew, Ethiopia
Gezai Abera	Raya University	Maichew, Ethiopia
Hagos Niguse	Maichew ATVT	Maichew, Ethiopia
Haile Kassa	Office of Agriculture -- Tigray region office	Maichew, Ethiopia
Tsegay Tiehari (??)	Raya Hadnet Union	Maichew, Ethiopia
Hagos Kidane	Alamata Research Center, TARI	Maichew, Ethiopia
Desbele Tasawe	Office of Agriculture -- Aleje woreda (crop expert)	Maichew, Ethiopia
Haftay Kahissay	Coordinator, GRAD	Maichew, Ethiopia
Amanuel Awash	Senior livelihood officer, GRAD	Maichew, Ethiopia
Workneh Dubale	Africa RISING Site coordinator Hossana, SNNPR	Hossana, Ethiopia
Girma Aba	Lemo woreda, Crop extension, Office of Agriculture	Hossana, Ethiopia
Girma Betebo	Hadiya zone offic eof agriculture, crop expert	Hossana, Ethiopia
Tsedeke Zewdie	Hadiya zone livestock and fishery team leader	Hossana, Ethiopia
Mesfine Desalegn	InterAide, Site Coordinator	Hossana, Ethiopia
Fitsam Debebe	Send a Cow	Hossana, Ethiopia
Ashenafi Abebe	Wachemo University, Research Director	Hossana, Ethiopia
Tesfaye Dejene	Areka Research	Hossana, Ethiopia
Kedrala Wabela	Worabe Research	Hossana, Ethiopia
Fekado Tesema	AR field assistant	Hossana, Ethiopia
Habtemu Forsido	Livestock & Fisheries Development Officers, Lemo District (AR focal person)	Hossana, Ethiopia
Mulatu Shomore	Child Fund (formerly World Vision)	Hossana, Ethiopia
Fikneab Mexebo	ECC SDCoHo (Catholic)	Hossana, Ethiopia
Wanjiku Gichohi	ICRISAT (nutrition)	Lilongwe, Malawi
Wills Munthali	ICRISAT (crops)	Lilongwe, Malawi
Mulundu Mwila	Agronomist, Zambia Agriculture Research Institute	Lilongwe, Malawi
Edward Mzumara	Africa RISING / MSU	Lilongwe, Malawi
Hannah Livuza	Africa RISING / MSU	Lilongwe, Malawi
Mphatso Gama	Extension, Malawi Ministry of Agriculture	Lilongwe, Malawi
Patrick Stanford	Machinga ADD (extension)	Lilongwe, Malawi
Agnes Mwangwela	Professor, Lilongwe University of Agriculture and Natural Resources, LUANAR (nutrition)	Lilongwe, Malawi
Isaac Maviko	MS student, LUANAR (agricultural economics)	Lilongwe, Malawi
Melise Mwachumum	MS student, LUANAR (nutrition)	Lilongwe, Malawi
Su Chowa	MS student, LUANAR (women / child nutrition)	Lilongwe, Malawi
Kondwani Luwe	MS student, LUANAR (Extension nutrition)	Lilongwe, Malawi
Tinashe Tarinsa	MS student, University of Zimbabwe / CIMMYT (economics)	Lilongwe, Malawi
Rahim Liguluwe	MS student, LUANAR (nutrition)	Lilongwe, Malawi
Francis Muthoni	IITA (GIS)	Dodoma, Tanzania
Christopher Mutungi	IITA (post-harvest)	Dodoma, Tanzania
Leonard Marwa	Tanzania Livestock Research Institute	Dodoma, Tanzania
Yasinta Muzanila	Sokoine University of Agriculture	Dodoma, Tanzania
Mawazo Shitindi	Sokoine University of Agriculture	Dodoma, Tanzania
Chrispinus Rubanza	University of Dodoma (livestock)	Dodoma, Tanzania
Inviolate Dominick	World Vegetable Center (agronomy)	Babati, Tanzania
Job Kihara	CIAT (agronomy)	Babati, Tanzania

Appendix 4: Project Sub-Activities, Program Outcomes, and Research Strategies

The following codes (for program outcomes, cross-cutting aspects, and research strategies) were applied to the Project 2018/2019 Workplans, specifically to information contained in the following sections of each Sub-activity description: (i) SI Domain; (ii) How will scaling be achieved; and (iii) How are the activities in this proposal linked to those of others? The resulting tabulations, while subjective enable detection of major patterns (described in Section 1.1)

Program Outcome Codes		Cross Cutting Codes		Research Strategy Codes	
1	Productivity	G	Gender	S	Systems
2	Economic	N	Nutrition	TO	Tradeoffs
3	Environmental	Y	Youths	T/E (E)	Typologies/Equity, mainly Equity
4	Social			T/E (T)	Typologies/Equity, mainly Typologies
5	Human				
6	Scaling-related				

Sub-Activity	Primary Program Outcome	Secondary Program Outcomes	Cross-Cutting	Research Strategy
GH111A-1801	1	2	G	T/E (E)
GH111A-1802	1		G	T/E (E)
GH111A-1803	1	2	G	T/E (E)
GH111A-1804	1			
GH111B-18	1			
GH112-1801	1			
GH112-1802	1		G, N	T/E (E)
GH121-18	1	2,3	G	S, T/E (E)
GH122-1801	1			
GH122-1802	2			
GH131-18	1			
GH211-18	5	2	G	S
GH212-1801	5	1	G	T/E (E)
GH212-1802	5		G	T/E (E)
GH311-18	3		G, Y	S
GH321-18	5		G	TO, T/E (E)
GH411-18	2	1	G?	S?
GH412-18	6			
GH421-18	1	2,3		S, TO?
MA1111-18	1	3		S
MA1112-18	3	1		T/E (T)
MA1113-18	1	2		
MA1114-18	1	2		
MA1121-18	1			
MA1122-18	1		G, N	
MA1131-18	2			TO
MA1211-18	3	1,2,5		S

Sub-Activity	Primary Program Outcome	Secondary Program Outcomes	Cross-Cutting	Research Strategy
MA2111-18	5	1	G,N	
MA4111-18	2	1	G?	S?
MA4321-18	2	1,3		S
MA4411-18	1	2,3,6		
ET-18/19/20: Forage	1	3	G?	
ET 18/19/20: Wheat	1	3?		
ET 18/19/20: SSMech	1	2		
ET 18/19/20: Water	3	1,2,5		
ET 18/19/20: Landscapes	3			S?
ET 19/20: Crowd	1			
ET 19/20: Enset	1	2?		
ET 19/20: Trees	1			
ET 19/20: Fert	1	3?		
ET 19/20: Gender	6		G	S, T/E (E)
ET 19/20: Nutrition	5	1		
ET 19/20: Innov. Platforms	6	4		S
TZ 1.1.1.1	1	2,3,4,5	G	
TZ 1.1.1.5	1	2,3,4	G	
TZ 1.1.1.6	1	2,3,4,5,6		
TZ 1.1.1.7	3	2, 5		S T/E (T)
TZ 1.1.2.1	1	2,3,4,5,6	G	
TZ 1.1.2.2	1	2,3,4,5,6	G	
TZ 1.1.2.3	1	2,3,4,5,6	G, Y	
TZ 1.2.2.1	1	2,3,4,5	G	
TZ 1.3.1.1	4	6		S T/E (T)
TZ 2.2.1.3	1	2,3,4,5,6	G	S
TZ 2.2.1.4	1	2,3,4,5,6	G	S
TZ 2.2.1.5	1	2,3,4,5	G	S
TZ 2.2.1.6	2	3,4,5,6	G	
TZ 2.2.1.7	2,4		G	T/E (E)
TZ 3.1.1.1	5	1,2,4	N	T/E (T)
TZ 3.1.1.2	2	5,6	G, N	
TZ 3.1.1.3	5	4	G, N	
TZ 3.2.1.1	5	2,4	G, N	
TZ 4.1.1.1	1	2,3,4,5,6	G	S
TZ 4.1.1.2	1	2,3,4,5,6	G	S
TZ 5.1.1.2	1	2,3,5,6		
TZ 5.1.1.3	6			
TZ 5.1.2.1	3	1,2,3,6		S
TZ 5.1.3.3	1	2,3,4,5		
TZ 5.1.4.1	1	2,3,4,5,6	G	
TZ 5.1.4.2	1	2,3,4,5,6	G	
TZ 5.1.6.1	6	1,2,3		S T/E (T)

Sub-Activity	Primary Program Outcome	Secondary Program Outcomes	Cross-Cutting	Research Strategy
TZ 5.2.1.1	6	4	G	T/E
TZ 5.2.2.1	6	4	G, Y	
TZ 5.2.2.2	6			
TZ 5.2.2.3	6			
TZ 5.2.2.5	6			
TZ 5.2.2.6	6			
TZ 5.3.1.1	1	2,3,4,5	G	
TZ 5.3.1.2	1	2,3,4,5	G	T/E (E)
TZ 5.3.1.3	6			
MW 1.1.1.2	1	2,3,4,5	G	
MW 1.1.1.3	1	2,3,4,5	G	
MW 1.1.1.4	1	2,3,4,5	G	TO, T/E (E)
MW 2.2.1.2	1	2,3,4,5,6	G	
MW 3.2.1.2	1	2,3,4,5	G	
MW 3.2.1.3	5	2, 4	G, N	
MW 5.1.3.1	1	2,3,4,5,6	G	S
MW 5.1.3.2	1	2,3,4,5,6		
MW 5.2.2.4	6			

Appendix 5: Example of gaps in Technical Reports

To illustrate some of the scientific improvements that can be made to AR Technical Reports (see Section 1.1-C), the Review Team gave a cursory review to the "Sustainable Intensification of Key Farming Systems in the Sudan and Guinea Savannas of West Africa Technical Report, 01 October 2018 to 31 March 2019"[182] and notes the following gaps:

- Table 3: where is weed yield listed? has it been included in fodder? What are the units for this table?
- Table 4: Weight gains due to what? Feed intake kg/per day? It is not clear what was actually fed.
- Average Weight Gain (is there a decimal point error)
- Figure 4: need to add key info in caption, e.g., what does "beneficiary", "non-beneficiary" mean? What does "preference" mean (work load, quantity of leaf obtained, etc.)? What are women's' role in maize in general (would they be expected to practice this technology because they own small ruminants that benefit from the stripped leaves, or would this be a men's role even if women own the small ruminants)?
- Table 8, Wouldn't regional comparison of be of primary interest (scaling)? Should weeds be considered a feed component? Perhaps weed have higher feed value than stover. Report all P-value (not clear what ns actually means, but I suppose its P-values >0,05)
- Table 13: "Time spent feeding the animals" (minute/day?)
- Pg 47, Where is the supporting evidence for "Households with feed and health intervention had more animals for sale through rapid flock growth and the proceeds from the sale was used to buy food for household consumption" and "Households with feed and health intervention had higher dietary diversity score than those in the control"
- pg 48 para 1 ".....maize shelling machines can substantially save labor by 80-95%, reduce drudgery, and save cost against the current manual method used by most of the farmers by 60-70%". How about provide income? What do they do with the saved labor?

[182] Gaps identified for this Technical Report are purely illustrative and do not suggest there is greater deficiency for this research area than for others.

Appendix 6: Farmer Discussion Group in Tingoli, Ghana

Survey of benefits and challenges of maize-cowpea intercropping (living mulch technology)
Conducted in Tingoli, Ghana on 19 September 2019 (approximately equal number of male and female farmers)

Benefit	1st round votes	% of total of 1st round responses	2nd round votes	% of total of 2nd round responses
Suppresses weeds	17	0.43	5	0.13
Conserves water for maize	8	0.20	20	0.50
Enhances soil fertility	15	0.38	15	0.38
Produces two foods (maize and cowpea grain)	0			
Controls *striga*	0			
Provides hay for livestock	0			
TOTALS	40	1.00	40	1.00
	Note: 1st round voting to rank all reported benefits		Note: 2nd round voting to rank benefits from 1st round	

Challenges		
Cowpea compitition with maize for water at tasseling	17	0.44
Labor intensive (more labor needed to weed maize around cowpea)	13	0.33
Pest on cowpea during drought	9	0.23
TOTALS	39	1.00

Method: All farmers were invited to identify all benefits of the maize-cowpea living mulch technology. Each farmer had one vote (show of hands) to what they felt as the highest benefit. A second round of voting identified the top 3 benefits. The same process was used to identify the greatest challenges (competition, increase labor to weed around CP), but there was not sufficient time to take a second vote.

Appendix 7: Examples of potential tradeoffs and synergies to analyse

During field visits, many farmers described benefits and challenges, including tradeoffs and synergies, related to AR technologies. Most commonly reported benefits included enhanced crop and livestock productivity, higher income, and some improvements in household nutrition. Most challenges related to tradeoffs in resource use, such as higher labor and input needs during technology implementation and maintenance. The list below illustrates the kinds of tradeoff and synergy analyses[183] that could inform new research directions and enhance technology adaptation to diverse AR target farmer populations.

Crop management

- For sorghum variety testing in Mali, various tradeoffs could be considered, such as among nutrition, income (e.g., grain sales to breweries), and use of residues for livestock feeding or soil fertility management.
- Farmers reported high labor demands for micro-dosing fertilizer (Ghana) and planting on a line (Malawi and Tanzania). The extra labor can slow progress of whole-farm maize planting, which can reduce yields. Possible tradeoffs could arise among productivity, labor, income, and nutrition.

Vegetables

- Across all regions, more information seems warranted on the type, amount, and timing of each vegetable's harvest, the fate of each vegetable harvest (sold or consumed), and impacts on income (and what is done with that income) and household (emphasis on child) nutrition. Possible synergies include among productivity, labor, income, and nutrition.

Crop residues

- Across all regions, more information seems warranted on crop residue uses (which impact household income if residues are sold), animal nutrition (if residues were fed), construction and fuel quality of stalks, and soil productivity parameters (e.g. erosion control; soil fertility). Possible synergies / tradeoffs include among productivity, income, environment, and labor.

Legumes

- What are the specific (seasonal) household impacts of legume products (grain, fodder) on household nutrition and animal production?
- Are there synergistic carry-over impacts on soil (e.g. nitrogen fixation) that can be attributed to cereal-legume rotations?

Soil management

- Contour bunding (Ghana, Mali), fanya juu, and tied ridges (Malawi and Tanzania) are environment-enhancing landscape technologies due to improvements in water availability to crops, reduced fertilizer runoff, soil erosion, etc. Forages are grown on bunds to provide animal feed. Tree plantings are used to demarcate field boundaries and land ownership (e.g. in Mlali, Tanzania). Potential tradeoffs can arise among runoff reduction, increased yield per unit area, income gains (e.g. selling or using wood and forages grown on contours), and cereal production displaced by contour bunds or trenches. It was reported (in Mali) that these land modification systems allow for abandoned eroded land to be brought back into production (with possible land use extensification-intensification tradeoffs).

[183] Note that the CGIAR's Independent Science and Partnership Council (now called the Independent Science for Development Council) concluded in 2018 that "the agricultural research community should avoid blanket recommendations to include tradeoffs / synergies in every research activity, but at the same time, do a better job at identifying key interactions and include them in the theory of change and impact pathways," focusing on transdisciplinarity (i.e. greater interaction among specialists in agriculture, breeding, nutrition, and climate). ISPC. 2018. Where Can Agricultural Research Most Contribute to Winning More, and Losing Less? Key Insights and Implications for CGIAR from Science Forum 2018.

- Farmers in Malawi reported that conservation agricultural practices increase maize productivity, but require more inputs (e.g. fertilizer; herbicides; labor) than conventional practices. In some areas, due to diminished availability of other fuel sources, there is increasing competition for maize stover between CA and household fuel needs. More targeted information seems warranted on relative tradeoffs in productivity, cost of inputs / labor, and opportunity costs of crop residue uses.
- Tradeoffs / synergies among reduced soil erosion, increased moisture retention, expanded growing season, increased fertilizer efficiency, increased yield and diversity of crops / forages, enhanced income, increased labor, installation costs, gender-differentiated benefits, and potential to catalyze extensification for contour bunding.[184]
- In Mali, tradeoffs / synergies among increased fertilizer use efficiency, increased crop yields, reduced nutrient loss in runoff, and increased labor (i.e. chopping cotton stalks) for composting cotton residues (which can be applied in targeted ways to maize fields).
- Tradeoffs / synergies among enhanced soil physical properties, nitrogen fixation, and enhanced soil fertility for succeeding crops for introduction of leguminous cereals and forages into traditional cereal-based cropping systems (similarly, synergies and tradeoffs associated with fodder beet in Ethiopia could be assessed).

Animal genetics, housing, and feeding

- In all regions, there's apparent high demand for improved housing and feeding strategies for small ruminants. It remains unclear the number and type (including gender) of adopters and how these technologies have been adapted. For example, some farmers seem to have significantly modified housing, feed storage, and feed trough constructions. In WA, there are gender differences in how technologies are applied: men using feed troughs for sheep and women for goats (which they prefer for their high reproduction).
- There seem to be multiple benefits that AR may not be capturing. In addition to enhancements in feed efficiency, animal production, and household income (in all regions, income due to animal sales is used to purchase diet supplements that reportedly enhance household nutrition), other farmer-reported benefits include saved labor in forage harvesting, transport, and guarding animals that allows children to attend more school.
- AR-promoted housing for goats in Malawi provides security against theft and predation by hyenas/jackals. The income from larger goats due to AR research on improved goat genetics is used to buy fertilizer and pay school fees.
- Tradeoffs / synergies of animal genetics, housing, and feeding could be assessed through field surveys, results which may lead to hypotheses development for further research on factors that further enhance impacts of livestock on household by gender, income, child labor, education, and nutrition.

Poultry

- Farmers in Mlali (Tanzania) reported that AR technologies related to genetics, feed milling, ration formulations, and housing have had positive synergistic effects on their farming systems. Income from sale of eggs was initially ranked the greatest benefit, followed by income derived from birds. When asked about manure, farmers reported that approximately one-half is applied to their own crops and vegetables, and the other one half is sold. When considering the beneficial effects of the manure on their crops / vegetables and income from manure, manure replaced eggs as having the most benefit to their whole farming system. Further study on the synergistic effects of imported feed nutrients on the whole farm system (i.e. imported feed not only benefits poultry production but also crop and vegetable production through manure) seems warranted.

[184] Which requires tracing and staking contour lines either manually using a water hose leveler, or mechanically with a leveler, amassing soil along the contour by passing three times on each side of the contour, compacting amassed soil to a height depending on slope of contours.

Mechanization of smallholder farms

- Farmers reported great labor savings using the maize grain thresher in Ghana and the feed mill (poultry) and forage chopper (ruminants) in Tanzania. Of primary interest would be to determine the amount of labor saved, what farmers actually do with this labor, and tradeoffs / synergies in economic, environmental, and human (nutrition) domains.

Nutrition

- In Nkhanganya village (Malawi), approximately 500 farmers have been involved in food and nutrition training. Dietary diversity and consumption patterns have been studied. During the field visit, women farmers provided excellent presentations of some 45 dishes of food ingredients, processed food, and dietary implications for the household in general and children in particular. This provided a direct testimonial to how well the nutritional training has reached this target population. A few things that came up during discussion: Men also cook. Yet no information seems to be available nor being collected on gender roles in various aspects of household nutritional outcomes (e.g. for a given major meal ingredient, such as a grain, production practices from crop planting through harvest, storage, processing, gathering of cooking fuel, food preparation).
- Women and men farmers in WA and ESA provided emphatic testimonials to benefits of improved nutrition derived from new processing and blending of the crops AR has been testing (e.g. maize, groundnuts, cowpea, and soybeans). The benefits include reduced stunting and wasting of children, enhanced physical structure and stamina for adults. Across all regions, it would be of great value for AR to know the actual prevalence of its advocated practices (e.g. nutritious ingredients; enhanced food processing and preparation). Follow-up studies seem warranted to determine the type and prevalence of meals prepared and fed, labor and fuel requirements, etc. It was reported that cooking more nutritional meals required more labor and fuel (albeit the benefits were certainly worthwhile).

Appendix 8: Illustration of adding gender dimensions to reporting

To demonstrate how brief descriptions of gender-specific roles in technologies and training could enrich reporting, the following questions relate to the 'Sustainable Intensification of Key Farming Systems in the Sudan and Guinea Savannahs of West Africa Technical Report, 01 October 2018 to 31 March 2019.' (Note that this Technical Report was considered to be representative of AR Technical Reports and was not selected because it was particularly deficient in addressing gender.)

- Figure 1. Why would women have a preference for groundnut varieties? What gender-specific roles do women have in the cultivation, harvesting, food preparation, marketing, etc. that would impact their variety preference?
- Figure 2. What influences gender preferences for plant density for growing groundnut? Are there gender differences in who actually does the work in groundnut fields (e.g., planting, weeding, harvesting)?
- Pg. 16: Would men and women be expected to perform leaf stripping?
- Figure 8c: Why might male farmers in Upper West score cowpea living mulch systems lower in terms of both social and human domains?
- Pg 38, Para 1: Women comprised 30% of farmer participants in a study of dual purpose sorghum cultivar for crop-livestock integration.
- Table 15: Why were both men and women trained in design and use of feed troughs (i.e., how are they each involved in livestock production)?